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Archival Record of Non-Seismic Data Processing

for

Marine Navigation, Gravity, Magnetic and Water Depth Data

R. Parums, P. Petkovic and D. Collins

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Record 1998/3

Australian Geological Survey Organisation
Petroleum and Marine Division

March 1998

Authors: R. Parums, P. Petkovic, D. Collins

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Foreword

The Non-Seismic Processing (NSP) section was initially set up to provide the Bureau of Mineral Resources (BMR) Marine Program with final processed navigation and geophysical data for its scientific surveys. The information contained in this archival record is an aggregation of the work that has been carried out to produce these data to the required standard over the past 15-20 years.

The record describes the methodologies and processing sequences used as well as the computer software which have been created and used in-house. It describes the processing programs (for pre- and post-processing of final raw data sets); programs used for quality assurance of the data and for providing report summaries; the maintenance of, and extraction of survey data from the marine data (MARDAT) databases; and the production of digital data and physical map products to meet the requirements of clients.

Since the loss of *Rig Seismic* and as AGSO no longer needs to be able to process its own navigation and geophysical data, this former working manual can be considered to be an archival record of the processing programs and methodologies used by NSP. The ASCII data formats (eg. time-based, UKOOA and MGD77) and the programs described in the sections on "Processing applications" and "Common Client Requests" will most likely continue to be used by the Marine Program. Computer programs used for quality assurance of UKOOA files; post-processing and statistical analyses of database files; database extraction and querying; and converting binary files to ASCII format would continue to be used.

At the time of writing (March 1998), the MARDAT database had been transferred to AGSO's Corporate Unix system and a relatively small amount of NSP FORTRAN programs had been transferred and successfully compiled.

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1. Introduction

Non-Seismic Data within the Marine Division of the Australian Geological Survey Organisation are all navigation, water depth, gravity and magnetics data collected by *R.V. Rig Seismic* and other research vessels.

Prior to 1994, the shipboard acquisition was based on a Hewlett-Packard (HP) 1000 F-series 16-bit minicomputer. The data acquisition system (DAS) programs ran under the HP/RTE operating system, either directly from the appropriate device through an RS-323C interface (gravity) or through an AGSO designed 16-bit digital multiplexer (magnetics, bathymetry). A gyro-log interface (for both sonar Dopplers and gyro-compasses) was attached to the digital multiplexer. After preliminary processing, plotting on strip-chart recorders and listing on several printers, those data were recorded on 9-track, 1600 bpi, phase encoded magnetic tape in HP's 32-bit floating point format. Data were acquired and saved every 10 seconds, regardless of ship speed. Data were written to magnetic tape in 1 minute blocks with 128 channels of data being recorded.

Since 1994, the shipboard acquisition system operated on a MicroVax 3500 computer. The programs ran under the VMS Version 5.5-1 operating system, directing devices either through an RS-323C interface (gravity meter) or through an AGSO-designed 16-bit digital multiplexer. After preliminary processing and plotting on strip-chart recorders, data were recorded on 7625 bpi, DDS/4mm data cassettes in floating point format. Data were acquired and saved to tape every 1 second, regardless of ship speed. Data were written to 1-minute blocks with 100 channels of data being recorded.

Processing of non-seismic data at AGSO in Canberra was performed mainly on VAX computers using FORTRAN programs under the VMS operating system. The programs that performed automatic and semi-automatic editing of the data exploited the SMG screen management routines supplied by VMS to provide user-friendly menu driven programs that were run using VXT2000 workstations or VT220 (or superior) text terminals.

A Microsoft Windows program written using C++ and running on networked PCs allowed viewing and interactive editing of the data. Other Windows programs were written in Microsoft Visual Basic.

2. File Types and Structures

Binary Data Files (.DAT)

The majority of processing is done on binary data random access, fixed-length-record files. All records within a particular file are the same length but this length can vary from one file to another - from 3 values (or channels) per record to 64 values per record. All values are held as 4-byte real numbers.

The first channel always represents the survey number and the Julian day number[1] of the year in the form SURVEY.DAY (104.040 - represents survey 104 on 9th Feb.)

The second channel in a record always represents the time (in GMT) and is represented as 0.HHMMSS (0.163403 represents 4:34pm and 3 seconds).

The third and fourth channels generally are latitude and longitude in radians. In order to preserve precision, the longitude has 100° subtracted from its degree value before it is converted to radians.

Answer Files (.ANS)

Answer files are text files used by the programs to supply default answers to menu options. There is a path that each executing program takes to determine which answer file should be used. If the user enters the name of the program that is to be run followed by the name of an answer file (with or without the .ANS extension) the program will look for the answer file first in the current directory and then, if it is not found, in the user's login directory. If an answer file is not passed as a parameter the program looks for an answer file with the same name as the program first in the user's login directory and then in the answer file directory. (The answer file directory is assigned the logical name NSP$ANSWERS)

Within all programs, after the menu selections are complete, you are asked if you wish to change the default answer file. If the answer is 'yes', the answer file in your login directory with the same name as the program will be overwritten with the options you have just chosen. If you wish to use this set of options in the future, then after running the program, go to your login directory and copy the default answer file to a file with a suitable name.

For example, after running FTAPE you may wish to store the chosen options permanently. Enter HOME to go to your login directory and then enter:

```
COPY    FTAPE.ANS    FTP1.ANS
```

From now on when you want to run FTAPE with these options, just enter:

```
FTAPE    FTP1
```

[1] For Continental Margins Survey (CMS) surveys, this is the day number starting from the first day of the survey.

An example of an answer file for FTAPE follows:

```
** FTAPE **

Read : SURV99.DAT
Write: FTAPE.DAT
Raytheon channels:  7  8  (2)
Mag. channels:  9  0  (1)
DEL spec. file: S99.FTP
FILL max. span(records):  360  No. FILL channels:  2
FILL channels and max. valid values:
  5         3.0000000000
  6         3.0000000000
```

Note: It can be useful, especially in batch processing to type out the answer file so that a record of the options chosen is recorded.

Caution:

Programs read answer files using formatted input, that is, all names and numbers have to be **exactly** in the correct columns, thus it is strongly suggested that you do not change answer files with an editor, rather run the program, change options using the menu system and then elect to change the default answer file within the program. (This method has the added benefit of integrity checks being applied to the chosen options.)

History Files (.HIS)

History files are ASCII files which document the cumulative history of their corresponding data files (normally .dat or .asc). A history file is automatically created for every process which changes the data. For example, if the input file for a particular process is *infile*.dat which produces a modified output file, *outfile*.dat, a history file called *infile*.his will be read (if it exists) and details of the current process appended to it and saved to *outfile*.his. After completion of the process, both history files will be retained in the working directory.

Important: In order to maintain this link, the user should remember when copying or renaming one of the data files to make the same change to the corresponding history file.

Directives Files

Most options required by processing programs are entered via menus, but in some cases long lists of directives are required. For example, when using FTAPE there may be a long list of intervals requiring data to be blanked out. In a case like this it is easiest to have a directives file that is read by the program. The format of the directives file for individual programs is found in the documentation specific to the program. Directives file names should end with a 3-character extension that resembles the name of the program in which it is used. (eg. A directives file for FTAPE should have the extension .FTP)

3. NSP Directory Structure

The top-level directory for the non-seismic data processing software is appl$soft:[nsp$soft]. Following are details on the sub-directories of [nsp$soft].

ANS

This is the directory containing the global default answer files for all NSP programs. (See *File Types and Structures*)

CVT, IO, MAP, MSC, PLT, SMG, DMS & STR

These directories hold the source code and libraries of general purpose routines. The routines are for conversions, I/O, mapping, miscellaneous, CGM plotfiles, screen management (menu routines), display graphics and character string manipulation, respectively. The names of the routines belonging to these libraries will begin with the sub-director name followed by an underscore (_) (with the exception of the MSC routines - these have no underscore in the name). Example library routines are str_upper, io_datinfo. Sometimes several closely related routines are held in the one source file - for example, routines str_upper and str_lower are held in the file str_uplow.for.

PROG

The source code for all NSP programs and program-specific subroutines is held in this directory, along with all the executable program files. The command line definition file *NOSDAP.CLD* is also in this directory. The .CLD file defines the parameters and qualifiers that may be used with a program.

4. Treatment of Data

Within the NSP system, general rules are followed and assumptions made about the data. It is important that subsequent programmers adhere to these rules and ensure that the assumptions made remain valid in order to maintain the integrity of the system. These rules are:

- All programs except for FIXTM and MLIST assume that there are no time jumps in the data file. That is, **every** record in the data file is a fixed time (eg. 10 secs) onward from the previous record. Generally, the NSP programs do not check for time gaps but proceed unaware of any error in the time. Thus it is essential to correct any time jumps (+ve or -ve) using program FIXTM before any other processing is carried out and to then verify with MLIST or STATS that there are no time jumps. New programs should be thoroughly tested to ensure that they do not corrupt the time channels (channels 1 & 2).

- In calculations, searches and comparisons, time is always converted to integer seconds elapsed in the year (of acquisition).

- Latitude, longitude and gravity are converted to double-precision real numbers before any calculations are done. Any other numbers involved in the calculations must also be of double-precision. General programs such as MATHS that **may** be used on these channels have all calculations done in double-precision. As a general rule, all calculations can be done using double-precision without any significant increase in processing time or memory requirements. Refer to the programs DPREC and SPREC used to test the difference between double- and single-precision calculations.

5. Setting up for Non-Seismic Data Processing

Setting up a NSP User

The user needs to have the following line added to his or her *LOGIN.COM* file:

$ @APPL$SOFT:[NSP$SOFT.DCL]NSP_ENVIR.COM

This VMS DCL file sets up all the required logical names and symbols to run the NSP programs and sets up all the NSP commands described in *NOSDAP.CLD*. The listing of *NSP_ENVIR.COM* at the time of writing (March 1998) follows:

```
$
$! NSP_ENVIR.COM - set up environment for an NSP user.
$!               - should be called from users' LOGIN.COM files.
$!
$! Author:              David Collins   April 1992
$! Mods:          Peter Petkovic   October 1992
$
$ set noon
$
$! DEFINE LOGICALS:
$
$ define soft           appl$soft:
$ define nsp$root       appl$soft:[nsp$soft.]
$
$ define nsp$headers nsp$root:[hed]
$ define nsp$answers nsp$root:[ans]
$
$! DEFINE SYMBOLS:
$ cd            == "@nsp$root:[dcl]cd.com"
$ set command       nsp$root:[prog]nosdap.cld
$ head*er       == "@nsp$root:[dcl]head"
$ hedit         == "@nsp$root:[dcl]hedit"
$ fixasc        == "@nsp$root:[dcl]fixasc"
$ answ*er       == "@nsp$root:[dcl]answ"
$ batch         == "@nsp$root:[dcl]batch"
$ remove        == "@nsp$root:[dcl]remove.com"
$ utils         == "@nsp$root:[dcl]utils.com"
$ concat        == "@nsp$root:[dcl]concat.com"
$ archive       == "@nsp$root:[dcl]archive.sub"
$ xarch         == "@nsp$root:[dcl]xarch.sub"
$ c             == "@nsp$root:[pfort]c.com"
$ pfdir                 == "nsp$root:[pfort]"
$
$!nosdap        == ""cd' dkb700:[nosdap]"
$ eve           == "edit/tpu/section=nsp$root:[dcl]eve.ini"
$ laser         == "print/que=llta9997"
```

```
$
$ set prot        =  g:rwed/default
$
$ if f$mode() .eqs. "INTERACTIVE" then set term/insert
$
$ cd
$
$ set on
$
```

Notes:

- The user should belong to the user group, NPD.

Setting up a NSP Programmer

Refer to Appendix 3 and the file: FREND$DKB700:[RPARUMS]LOGIN.COM

```
$ set noon
$ define nsp$disk USR$NSP
$ @nsp$disk:[nsp$soft.DCL]NSP_ENVIR.COM          !Command to setup NSP environment
$
$! Set terminal type
$ set term/device=vt200
$
$ define/NOLOG FREND_sys$print llta9996
$ laser         :== print/queue=llta9997
$
$!setup for digitizer
$ assign tt digitizer
$ assign digitizer dci_digitizer
$ assign/user sys$command sys$input
$
$ del           :== delete
$ gp            :== set protection=(G:rwed)
$ cls           :== ""esc'[2j"
$ dir           :== directory/size=all/date/prot
$ dd            :== dir *.dir
$ de            :== del/entry=
$ w80                   :== set terminal/width=80
$ w132          :== set terminal/width=132
$ sd            :== set default
$
$ set protection=(S:RWE,O:RWED,G:RWE,W:RWE)/default
$ set process/privilege=all
$
$ s170          :== 'cd' frend$dka400:[nsp5.s170]
$ soft          :== 'cd' appl$soft:[nsp$soft]
```

```
$ prog          :== 'cd' appl$soft:[nsp$soft.prog]
$
$ nsp1          :== 'cd' nsp$disk:[nsp1]
$ nsp2          :== 'cd' nsp$disk:[nsp2]
$ nsp3          :== 'cd' nsp$disk:[nsp3]
$ nsp4          :== 'cd' frend$dka200:[nsp4]
$ nsp5          :== 'cd' frend$dka400:[nsp5]
$ ti            :== 'cd' nsp$disk:[nsp3.ti]
$ uk            :== 'cd' nsp$disk:[nsp3.uk]
$ misc          :== 'cd' nsp$disk:[nsp1.misc]
$
$ purge/keep=2 *.*
$
$ lnk           == "@nsp$root:[dcl]lnk.com"
$ lnkall        == "@nsp$root:[dcl]lnkall.com"
$ listsubs      == "@nsp$root:[dcl]listsubs.com"
$ lists         == "@nsp$root:[dcl]lists.com"
$ gets          == "@nsp$root:[dcl]gets.com"
$ getp          == "@nsp$root:[dcl]getp.com"
$ mkl*ib        == "@nsp$root:[dcl]mklib.com"
$ msl*ib        == "@nsp$root:[dcl]mslib.com"
$
$ say           == "write sys$output"
$
$ define dcipls dci_lib:dcipls.exe
$ define dciold dci_lib:dciold.exe
$ define dciosi dci_lib:dciosi.exe
```

6. Processing of Data

The following guidelines describe the stages of processing the non-seismic geophysical data from a typical seismic survey to produce a UKOOA format file containing position at the shot, water depth, gravity and magnetic total field. The processing of surveys that do not acquire regular seismic data (e.g. geological surveys) is a subset of the process described.

Before commencement of processing in the office, obtain the following:

- A tape or tapes containing raw navigation data from the ship. The dataset usually exists on a single DAT tape and is in VAX backup format. Since the processing has been conducted on board the ship, a DAT tape is produced which contains all the files in the survey directory tree. These files are then downloaded into a working directory on the office system where the processing is completed.

- A shot-time file (for seismic surveys) which usually exists on a 3480 tape cartridge. The square tape drive must be connected to FREND for this.

- All relevant paperwork. For example, any processing agreements (contracts), parameter reports, line logs, operational or cruise reports.

When running processes on the data, it is recommended that the syntax for naming VAX binary floating point files be SnnnXXXm.DAT, where

nnn	represents survey number,
XXX	is an abbreviation of the last process run to produce this file, and
m	represents a survey part number, if required.

Phase 1 - Compilation of Survey Data

In Phase 1 the non-seismic field data on the DAT tape and the shot times file on the 3480 cartridge are read into the survey project directory on the VMS system. Refer to Section 8: *UTILITIES (Copying files to and from tape with VMS backup).*

SWAP - Extract the relevant channels from the data file and create a 30-channel file. Refer to the full channel allocation table in Appendix 4. The recommended channel allocation after swapping the channels can be found in the "Non-seismic Processing on board Rig Seismic, Notes for Processors" document. The channels required will be:

the best estimate channels for position,
the GPS channels for both systems (lat, long, time of record, time of fix),
the geophysical data and water depth channels,
the heading (optional),
the shot time and shot number channels (only in surveys prior to survey 110)

XTIME - This program reads the file and skips the records with bad times on output.

FIXTM - Correct time order errors with FIXTM.

Phase 2 - Processing of Navigation

Phase 2a - Processing of the time-based navigation file

RESAM - Resample the 30-channel binary file to 10-seconds.

IGPS (2 passes) - Interpolate Racal #1 and Racal#2 positions back to the 10-second mark after allowing for the time lag between the time of satellite fix and the time of output record.

BADLL (2 passes) - Replace any bad lat/long values with unknown values.

FDATA - Remove spikes.

FTAPE - Automatically interpolate across gaps in the navigation. Normally interpolation is carried out where data gaps are about 3 minutes or less.

FINAV (rarely used) - Using the plots generated in Phase 1, decide on the best blend of systems and create a control file. Blend systems. If navigation data quality is good, the blending may be done interactively using PCEDAT described below. If it is necessary to use dead-reckoning for any part of the survey, refer to the notes at the end of this section under the heading QDR.

PCEDAT - View and edit lat/long channels. If necessary, copy the file to your PC's disk in order to speed up response. (Upon completion, copy it back to the Vax system using DATCOPY.BAT.)

SMTH - Smooth the positions.

NAV2NRP - Translate the navigation position at the antenna to the Navigation Reference Point (NRP).

PSMAP - Plot a map of the final navigation (ship's track) and check this with the project leader and non-seismic processing manager.

RESAM, SWAP - Resample the 10-second file to 1 minute and create an 8-channel file to place a copy in the [.TI] directory. The generic name for the file at this stage in the processing should be SnnnFN.dat, where nnn is the survey number.

PLTCH (optional) - Plot all channels using a time scale of 2 cm per hour and have it checked.

At this stage, a cumulative history listing should be printed and retained for QC.

Phase 2b - Preparation of the shot times file and final navigation

Get reports and line summaries for the survey and extract the shot-points at which the near offsets changed, the amount of the near offset and the antenna-to-source offset.

Get information on whether final shot positions will be required at antenna, source or common mid-point (CMP).

Get information on first and last chargeable shot for each line. Edit shot-times file so that only the chargeable shots are contained in it. Use CHECKST to assist with this.

Prepare near offsets file according to format required by DELAY.

DELAY - Apply a time delay to the shot-times file so that the output shot-times file has times at which the antenna was at the seismic stack point (SSP). This is normally placed either at the source or at the common mid-point location.

STFIL (optional) - Fill gaps in shot times file.

UKOUT - Using the final 10-second navigation file and the DELAYed shot times file as input to UKOUT, create a high-precision, UKOOA format output file. This will contain the position at the SSP for every shot.

UKCHECK - Check the UKOOA file for shotpoint continuity and anomalies in shotpoint interval.

UKOSAM - In order to produce a file suitable for input into Petroseis or for loading onto a floppy disk, sub-sample the UKOOA file. This program may also be used to produce all, none or some of the geophysical data.

PETROSEIS/PSMAP - Generate the final shot-point location map as required by the project leader or external client.

Phase 3 - Processing of Gravity, Water Depth and Magnetics

Phase 3a - Water depths

FTAPE (2 passes) - (1) Remove water depth data containing error flags and (2) Fill gaps in the data of up to 1 minute.

RESAM - Resample data frequency from 1 second to 10 seconds.

MATHS - Negate the water depth values.

PCEDAT - Interactively edit the water depths using this PC-based editor. Decide on the type of editing (PCEDAT and/or SALVG) to be performed after inspecting the digital data and analogue charts.

DIGIT/EPCTIME (if required) - Digitise the water bottom over areas of poor data quality with program DIGIT. Run EPCTIME as a preparatory program before running SALVG.

SALVG (if DIGIT used) - Inspect the analogue water depth records in the areas where the digital water depth data are poor and use the EPCTIME output as a control file (Some editing may be necessary on this file). SALVG has a default threshold value of 5 m which is normally adequate for a first run. This threshold may be reset and the general rule to apply is:

1 - 3 m	if the water bottom is very flat,
8 - 15 m	for data that is not too noisy in a rapidly changing water bottom.
4 - 7 m	in other instances

MATHS - Make draught offset correction to water depth data.

MERGE - Merge the water depth data into channel 5 of the file containing the final 10-second navigation.

RESAM (if required) - Create a 1 minute file.

Phase 3b - Gravity

RESAM - Resample data frequency from 1 second to 10 seconds.

MERGE - Merge the raw gravity data from the DAS file into the 10-second file containing the final navigation data. This will be used later in the EOTVOS routine.

FTAPE - Interpolate the gravity over gaps in the data of up to 3 minutes.

FDATA - Remove spikes from the gravity data.

MATHS - Convert the gravity data from mgal units to micrometers/sec**2, (1mGals = 10 µm/s/s)

GSHIFT - Shift gravity data (in time) to compensate for the gravity meter filter lag.

FINAV or EOTVOS - Compute the gravity tie and execute FINAV to tie the gravity to datum and make the Eötvös correction.

PCEDAT - Interactively edit the gravity using the PC-based editor. The main type of manual editing that needs to be routinely done is interpolation to eliminate turn effects. This should not extend over more than about 15-20 minutes.

SMTH - Smooth the gravity data using a 3-minute period filter. If there is still significant oscillation in the data at this stage, a 15-minute filter can then be used.

MERGE - Merge the gravity data into channel 6 of the file containing the final 10-second data.

Phase 3c - Magnetics

RESAM - Resample data frequency from 1 second to 10 seconds.

FTAPE (2 passes) - (1) Remove magnetics data containing error flags and (2) Fill gaps in the data up to 3 minutes.

FDATA - Remove spikes from the magnetics data.

PCEDAT - Check and interactively edit the magnetics using the PC-based editor. Typical errors to note are (i) zones of constant values, where the magnetometer has not recorded any valid data and (ii) anomalous magnetic responses on turns due to the magnetometer being closer to the ship than normal (< ~200m).

SMTH - Smooth the magnetics data using a 3 minute period filter.

Magnetics - correction for offset from antenna

For this sub-process, extract the smoothed mag data into a temporary file with, final lat/long in channels 3 & 4 and the magnetics data in another channel.

TSHIFT - Apply time shift to the data file which contains the magnetic total field values. You will notice that the times in the output file are not on a 10 second timing mark. The amount of time shift (δt) is equivalent to the amount of time it took the ship to travel a distance d, where

$$d = \text{antenna to stern} + \text{length of mag tow cable}$$

and so, $$\delta t = d / \text{speed}$$

TSHIFT assumes that d does not change for the whole data file and is the value you supply to the program. TSHIFT computes the speed itself by dividing the distance travelled by the sample interval.

ATSEC2 - Now do an interpolation of the mag values to the 10-second timing marks.

FIXTM - Fix time order errors produced in the ATSEC2 process.

PCEDAT - Check the data using a PC-based editor. The data between the two systems should be patched and the best possible data set compiled.

MERGE - Merge the magnetics data back into channel 7 of the final 10 second data file. Create an 8-channel file and place in the [.TI] directory.

ANOM - Convert the gravity data to free-air anomaly values and magnetics data to IGRF anomaly values. Place these in channels 9 and 8 respectively and then put the file into the database.

CRUX, MSTATS - Compute the intersection points and misties as an aid to checking the data.

PSMAP - Draw track, posted value or profile maps if required.

Phase 4 - Production of Final Data Files

UKOUT, UKOSAM - Create the final shot location file containing the geophysical parameters.

SPNUM - if necessary, resequence and rename lines in UKOOA file.

PETROSEIS/ISECT - Generate an intersections and misties listing.

PLTCH (optional) - Plot the data, including the navigation and have it checked.

ARCHIVE (optional) - Complete the archiving, as follows:

Phase 5 - End of Processing Archiving

The following should be copied to exabyte tape at the end of the processing, 1 tape per project.

10-second Floating Point file (SnnnARC.DAT)

1	sss.ddd
2	.hhmmss
3	final latitude
4	final longitude
5	latitude after blending of systems
6	longitude after blending of systems
7	gravity prior to sampling to 1 minute, Eötvös correction and tie
8	final magnetic field #1
9	final magnetic field #2 (if second channel is recorded)
10	SALVG'd 3.5 kHz
11	SALVG'd 12 kHz
12	final water depth with draught correction

ASCII files

Shot times file after edits applied

Near Offsets file

UKOOA file prior to resequencing and merging of seismic lines

SALVG control file(s)

FINAV control file

FIXTM control file

Documentation

List of what has been archived

Processing notes

10-sec data plots

Systems Post-cruise report

Channel allocation for raw data file (if not in systems report)

Resequencing specifications for UKOOA data

Any communications from Marketing

SURVEYS.DOC to contain basic information about acquisition and processing, such as the following:

Vessel: Rig Seismic *Dates of Acquisition: June/July 1993*

Navigation Systems: Racal "Skyfix" differential GPS

Gravity Processing: Gaps filled; despiked; sampled to 1 minute; Eotvos correction; tied to Isogal 84; smoothed using 15 minute period filter; edited for turn effect.

Magnetics processing: Gaps filled; despiked; smoothed with 3 minute period filter; edited for gap effect; sampled to 1 minute. Note that jumps at turns exist.

Water Depth Processing: manually corrected 3.5 kHz digital record using values from analogue records; assumed speed of sound 1500 m/s; sampled to 1 minute.

Navigation Processing: Used Racal #1 throughout; gaps filled; IGPS process; edited for dropouts; smoothed using 3 minute period filter; sampled to 1 minute. Shot times from seismic system corrected to CMP using speeds computed from final 10 sec navigation.

Then subsequent survey processing can refer to "as above with the following variations:"

Quality Assurance

A high quality of life depends upon high quality work and this is true on both the individual level and at the level of society. The need for timely production of a good quality product or service is also an axiom of survival in the present economy.

The quality is defined in terms of the standards required by the recipient of the product and therefore these standards have to be clear at the outset. In order to assure quality in the product it is essential that the work be done with quality tools operated by a skilled worker. More importantly, it is also essential that the person doing the work has an attitude which favours care and precision in the production process.

Below is a summary of the tools and processes which are specifically in place to assist in checking the quality of production:

UKCHECK, UKLABS (Phase 4)

After creating a UKOOA file, either complete or sampled, UKCHECK performs validity checks on distance and time intervals. UKLABS provides position, shotpoint number and time ranges for each seismic line in the file. The range of data values contained within the file can also be output.

Communication

Processing of non-seismic data is not such a mundane affair that problems never arise. It is a good problem solving technique to involve colleagues in the problem solving process. In particular, unusual features in the data should be brought to everyone's attention, including the supervisor.

All final products need to be checked by the supervisor. Project leaders need to be involved wherever possible and especially at critical stages such as setting up of the processing agreement and production of final product.

Problems, inadequacies or new ideas relating to the processing software and methodology should be communicated to the supervisor.

STATS (Phase 2, 3)

This program performs a range check on values in all channels. It also reports the number of valid and blank values, the number of gaps and number of zeroes contained within each channel.

PSMAP (Phase 2, 3)

Mapping tool for time-based and (shot-based) files. In this phase, PSMAP is used an aid to viewing the position data.

INFO (All Phases)

INFO reads a NSP binary file and returns the survey number, number of records, number of channels, sample interval (secs) and the time range of the data.

MLIST (All Phases)

MLIST is a basic display tool and should be used frequently to check the reasonableness of the numbers in processing channels.

CRUX (Phase 3)

This program computes the mistie at intersection points. It will give information about bad values at intersection points.

PCEDAT (Phase 2, 3)

PCEDAT is sophisticated data viewing and interactive editing tool. It allows a display of ship's track alongside the t-y graph and makes checking of corrections a straightforward task. Because interactive manual edits cannot be reproduced automatically, it is worth emphasising here that PCEDAT should only be applied to a copy of the data. That is to say, copy channel 1 to channel 2 and work on channel 2.

PETROSEIS (Phase 2, 3, 4)

Petroseis will plot shot point location maps, posted value maps, mistie maps, compute intersections between lines, plot spn-y graphs of data along a line, contour maps and several other functions.

PLTCH (Phase 2, 3)

PLTCH is a basic tool of data display. As every job consumes considerable time and paper, it is important that care is taken in setting up the control parameters to give the maximum information for each plot.

Processing Notes

The keeping of accurate and informative processing notes is an essential part of maintaining a continuity of knowledge of the processing sequence. It is especially important to keep processing notes of a high quality when the processor is given some freedom in the choice of tools and processing sequences. This freedom is allowed in order to encourage inventiveness and an understanding of the process, but carries with it the responsibility of documenting exactly what is done, why and when. This is supplemented by maintaining the process history for each binary data file (See .HIS files).

Testing

Before application of automatic corrections and filters it is important to test correction parameters before application. This will be the case in the execution of SALVG, SMTH and FDATA.

To facilitate this we need to create a tool for interactive filtering so that the testing can be carried out more easily.

Processing Standards

NAVIGATION

- Before application of the smoothing filter, the steps and spikes in the latitude and longitude channels should not exceed 10m.

- The precision required of the position data is to the 7th decimal place in radian measure (0.64m ~ $1x10^{-7\,c}$). This is important in any transfer of data using ASCII files.

- Blending of navigation systems should always be done using a ramp of at least 10 minutes.

- Linear interpolations should never exceed 15 minutes of ship time (2 km) in the best conditions of sea state and ship motion, and should be done only if there is good corroboration from other systems that significant course changes have not occurred. Under normal circumstances, interpolations should be kept under 5 minutes (750 m at 5 knots). Bad data over longer periods is best deleted if dead-reckoning data is not available. Note also that dead reckoned positions no longer give acceptable accuracy for periods in excess of 1 hour. If dead-reckoning must be used for critical lines as given in the processing agreement, consult with the supervisor and project leader.

- In deciding upon a blend of GPS navigation systems, only use systems which recorded a dilution of precision (dop) of 5 or less. If you are forced to use lower quality dops, be careful to make a note of the period in the processing notes so that spurious effects can be examined at a later stage.

WATER DEPTH

- Water depth data should not be filtered, but random noise levels should not exceed +/- 10 m for 10-second data.

- Digitisation of EPC records should be performed such that all inflection points, maxima and minima are picked and digitisation density is sufficient to pick up features of high curvature.

- Water depth misties should not exceed 15m.

MAGNETIC FIELD

- Magnetic field misties should not exceed 20 nTesla.

GRAVITY FIELD

- Gravity data would not normally exhibit rapid rates of change. (This is theoretically improbable as the gravity response is a summation of the entire density distribution around the measuring point and inversely proportional to the square of the distance between the mass and the measuring point. One could expect a rapid rate of change over features such as sea-mounts etc).

- Gravity misties should not exceed 50 $\mu m/s^2$.

7. DCL (.COM) Programs

DCL (DEC Control Language) files are text files that simply contain a series of VMS commands. They are the VMS equivalent of DOS .BAT files (although much more sophisticated and powerful). DCL files are used to provide useful utilities in the NSP system. All DCL files used in the NSP system are held in the appl$soft:[nsp$soft.DCL] directory.

ANSW.COM

Displays the default answer file for a program. (See *File Types and Structures*)
To read the default answer file for the program MLIST, enter: ANSW MLIST

ARCHIVE.SUB

Menu driven utility for all functions related to archiving data. (See *Archive Utility* below)

BATCH.COM

Menu driven utility to perform functions related to batch processing. (See *Batch Utility* below).

CONCAT.COM

Joins data files together, for example:

CONCAT s107a,s107b,s107c s107

> ie, join S107A.DAT, S107B.DAT, S107C.DAT together to form a file called S107.DAT. **The original files and their headers are deleted.** A header for S107.DAT is created.

Because of the danger of losing files and because the header transfers are no longer vital to the operation to the system, it is advisable to use the VMS APPEND command for this purpose.

FIXASC.COM

Sometimes ASCII files transferred from another computer have the wrong VMS file type for NSP programs. Typically this results in the message 'Open failure' when a program tries to read the ASCII file. In this situation for the file SURV99.ASC, for example, enter:

    FIXASC SURV99

HEAD.COM

Displays the header file associated with a data file. (See *File Types and Structures*)
To read the header of SURV99.DAT, enter: HEAD SURV99

HEDIT.COM

Edits the header associated with a data file (See *File Types and Structures*)

To edit the header of SURV99.DAT, enter: HEDIT SURV99

NSP_ENVIR.COM

This sets up the environment for a NSP user. (See *Setting up a NSP User*)

REMOVE.COM

Use this for deleting a data file **and** its header. The user is prompted [Y/N] before the delete of each file.

REMOVE s107 - delete S107.DAT (if it exists) and its header S107.HED

UTILS.COM

Displays a list of the utilities on the system.

8. Utilities

ARCHIVE Utility

The ARCHIVE utility is a menu system for all functions related to the archiving of data - except for the reporting of available empty tapes - this is done by the marine-wide TMS system. To find out the names of available empty tapes enter TMS on the VAX command line and use the menus to list scratch tapes. *NSP* tapes are numbered from 40116 for exabyte and sy0000- for 3480 cartridge.

For all other archiving functions, enter ARCHIVE. The following will appear:

```
*** Archive Menu ***

1. Archive files to a tape.

2. Mount a tape and list its contents.

3. Restore file(s) from a tape onto disk.

4. Look at log files for 1,2 & 3 (above)

5. List the labels of tapes that contain a specified file.

6. List all details about a specific tape.

0. EXIT

Choice:
```

Following is a list of options and the actions that follow each option.

Archive files to a tape

Label of tape to write to: 040116

APPEND to end of existing tape files or OVERWRITE (a or o)

(specify OVERWRITE if the tape is new): a

Files to backup - eg. frend$dub2:[nosdap.data]S109.DAT,DC*.DAT*
(in the above example, the directory frend$dub2:[nosdap.data] is assumed for DC.DAT)*
: frend$dub2:[nosdap.dcl]*.com

Enter the TMS setname: <description>

6-character description of data being archived (eg ARC180): DCLFLS

Continue(Y or n): y
Job ARCHIVE (queue NSP$BATCH, entry 729) started on NSP$BATCH

After sending the job advise the operator to release ENTRY 729 ON batch queue nsp$batch, as follows:
$ set entry/release 729

Mount a tape and list its contents

Label of tape (eg. SY0000) to mount and perform a listing of:
(Press the RETURN key to do nothing): sy0057

Job MOUNTLST (queue SYS$BATCH, entry 730) started on SYS$BATCH

Restore file(s) from a tape onto disk

Label of tape to restore file(s) from: sy0000

Name of saveset (eg. 12544588.bck) on the tape containing the files: 14423427.bck

Disk and directory (eg. frend$dub2:[nosdap.dat]) to restore files to: frend$dkb700:[nsp1.data]

Files to retrieve - eg. [nsp1.data]S109.DAT,DC*.DAT*
(Do NOT specify a disk name.): s0*.dat

Continue(Y or n): y
Job RESTORE (queue SYS$BATCH, entry 731) started on SYS$BATCH

Look at log files for 1,2 & 3 (above)

With all the above three options, a job is submitted to the batch queue. This option allows the user to look at the log files that are created in his/her log-in directory to see how the batch job is proceeding.

List the labels of tapes that contain a specified file

This option and the following option extracts information from list files produced by all *NSP* archives. This is the quickest way to display information about archive tapes. (Option 2. above is only used in unusual circumstances.) This option simply asks for the name of the file you are looking for.

List all details about a specific tape

The user is simply asked for the name of the tape (eg. sy0034).

BATCH Utility

All non-graphical VMS programs can be run interactively (using menus to choose options) or in batch mode. When a program is run in batch modes the same system of answer files applies as when it is run interactively. That is, if an answer file is not specified as a parameter the default answer file in the user's login directory is used. (See *File Types and Structures*)

The functions performed when running programs in batch mode are provided by a menu-driven utility that is started simply by entering: BATCH

The following screen will appear:

```
                    *** BATCH MENU ***

     1. Submit batch job.

     2. Look at a LOG file.

     3. Stop a batch job.

     4. See how busy the VAX is.

     5. Purge LOG files.

     6. Run a program while you wait, capturing output in a file.

     0. EXIT

Choice:
```

Following is a list of options and the actions that follow each option.

Submit batch job

Enter the name of a .COM file to be submitted to the batch queue.
The .COM file is then placed in the editor for the user to modify. An example of a .COM file is:

```
$! TEST.COM
$!
$ set verify              ! echo commands
$ set default frend$dub2:[nosdap.dat]
$
$! Run MLIST with default options
$ mlist
$
$ set noverify
```

Press the F10 key to leave the editor when all changes are made.
The following appears:

```
Time at which to run job:

To run job at 4:30pm today, enter:          16:30
At       4:30pm tomorrow:         tomorrow+0-16:30
At       4:30pm in 2 days:        tomorrow+1-16:30

Or press RETURN for NOW
Or enter Q to QUIT

Time you want the job run:
```

Enter your choice. The following type of message will appear:

```
Job TEST (queue SYS$BATCH, entry 729) started on SYS$BATCH
```

Look at a log file

For each batch job a log file is created in the user's login directory. This contains the output from the program. The following type of message appears:

```
Log files:

Directory FREND$DUA1:[D_COLLINS]

DECW$SM.LOG;9    DECW$SM.LOG;8    DECW$SM.LOG;7    DECW$SM.LOG;6
TEST.LOG;15      TEST.LOG;14

File to view (without .LOG extension)
(or Press RETURN for none): test
```

The file will then be listed. Press Ctrl-C to abort the listing.

Stop a batch job

The following type of information will appear:

```
Job Queue
Batch queue SYS$BATCH, on FREND::

 Jobname     Username    Entry     Status
 -------     --------    -----     ------
 TEST       D_COLLINS    729     Executing

Entry number of the JOB to stop (Press RETURN for none): 729
```

See how busy the VAX is

The following type of information will appear:

```
              VAX/VMS Monitor Utility
              TOP CPU TIME PROCESSES
                 on node FREND
               8-MAY-1992 11:40:45

                                 0        25        50        75       100
                                 + - - - - + - - - - + - - - - + - - - - +
202000F9  RWHOD                  5 •••••••
                                 |         |         |         |         |
20200545  D_COLLINS              5 ••••
                                 |         |         |         |         |
202000DE  MSAF$SERVER0           3 ••
                                 |         |         |         |         |
202000BD  PCFS_SERVER            3 ••
                                 |         |         |         |         |

                                 |         |         |         |         |

                                 |         |         |         |         |

                                 |         |         |         |         |

                                 |         |         |         |         |

                                 + - - - - + - - - - + - - - - + - - - - +
```

This display shows what percentage of the CPU each process is using. The VAX is busy if the displays for the different processes total about 100%.

Purge log files

After a time, many old versions of log files will exist. These must be deleted. A purge will delete all but the most recent version of each of the files. The following type of information will appear:

```
Directory FREND$DUA1:[D_COLLINS]

DECW$SM.LOG;9    DECW$SM.LOG;8    DECW$SM.LOG;7    DECW$SM.LOG;6
TEST.LOG;15      TEST.LOG;14

%PURGE-I-FILPURG, FREND$DUA1:[D_COLLINS]DECW$SM.LOG;8 deleted (6
blocks)
%PURGE-I-FILPURG, FREND$DUA1:[D_COLLINS]DECW$SM.LOG;7 deleted (0
blocks)
%PURGE-I-FILPURG, FREND$DUA1:[D_COLLINS]DECW$SM.LOG;6 deleted (0
blocks)
%PURGE-I-FILPURG, FREND$DUA1:[D_COLLINS]TEST.LOG;14 deleted (846
blocks)
%PURGE-I-TOTAL, 4 files deleted (852 blocks)
```

Run a program while you wait, capturing output in a file

Sometimes you may wish to run a *NSP* program and capture what normally is output to the screen, in a file. First run the program interactively, setting the options with menus and saving these as the default options. Quit the program after saving the default options. Then enter the command *batch and* choose *Run a program while* . The following type of information will appear:

The program specified will take its options from the default answer file or a specified answer file. NO menus will appear. The output will be written to a file of your choice.

```
Program to run (or press RETURN to quit): mlist

Answer file to use (or press RETURN for default answer file):

File to write output to (or press RETURN to quit): tmp.txt

The program will now run invisibly (while you wait). To abort the program press Ctrl-C.
```

Restore_NSP Utility

The system manager performs daily, weekly and monthly incremental backups. If a file is lost, there is a chance that it can be restored from the system backups. See file:

appl$soft:[nsp$soft.dcl]RESTORE_NSP.COM

Make a copy of this file into your home directory and edit it according to the instructions contained within it.

```
$! RESTORE_NSP.COM
$! to restore files from backup tapes
$
$ set ver
$ mount/for frend$mka0:
$!
$! command syntax is:
$!
$!  $ backup/log frend$mka0:*/save/sel=file_specification -
$!      device_name:[*...]*.*/new/owner_uic
$!
$! You can place saveset_name for the first *, if you know it
$!
$! To get save_set name:
$!  $ set def appl$soft:[backup]
$!  $ search daily.log FREND$DKB700/output=temp.lis   or
$!  $ search daily.log;-1 FREND$DKB700/output=temp.lis  for backup
$!       from the previous day
$! You can search also weekly or monthly backups.
$!
$! Then submit job:
$!
$!  $ submit/queue=frend_batch/hold/noprint/notify restore_nsp.com
$!
$! and notify operator to release the entry number after tape is
$! ready in drive
$!
$ backup/log frend$mka0:FREND$DKB700_2NO/save/sel=xlist_hex.for -
        FREND$dkb700:[*...]*.*/new/owner_uic
$ exit
```

Copying files to and from tape with VMS Backup

To recover files saved to 4 gigabyte DAT tape with VMS BACKUP (eg DAS data files from the ship):

BACKUP/LOG MKA500: *.*
DISMOUNT MKA500:

To recover files saved with VMS BACKUP to 2.5 gigabyte Exabyte tape format (e.g. shot times files):

BACKUP/LOG MKA500: *.*/SAVE [...]*.*
DISMOUNT MKA500:

The "[...]*.*" will reproduce the directory structure that was saved with the files.

Interactive Backup to 3480 square tape

It may become necessary to interactively archive files from disk to tape using the VMS Backup utility on GARP2 without submitting a batch job on NSP$BATCH. For instance, when transcribing old HP format processing tapes to the VAX for archiving to square tape without operator assistance. If you have not already done so, you should allocate yourself tape(s) in the TMS system before commencing. Take some blue shell 3480 tapes from the racks and label with NSP stickers (SY-series) from the operator's room.

1. Tape handling

The following instructions are useful:

MOUNT/FOR MUD0: or, MOUNT/NOLABEL MUD0:	!Mount a tape in device MUD0: without prompting for the tape label
DISMOUNT MUD0:	!Rewind, dismount and unload the tape, releasing the drive
DISMOUNT/NOUNLOAD MUD0:	!Rewind the tape to BOT without unloading the drive

Remember to MOUNT after DISMOUNT!

2. Initialising a new 3480 square tape

If you start with a new tape you will need to initialise it. Insert a blank square tape in one of the two GARP2 tape drives. The prompts are as follows:

INIT	!Run INITIALIZE
_*Device:* MUD0:	!Type the device name (either MUD0: or MUD1:)
_*Label:* (tapelabel)	!Type the (tapelabel). Normally six digits (SY and 4 numbers)

INITIALIZE will not mount the tape and may even eject the tape, so if you wish to see if it has initialised correctly, then push the tape back in and:

MOUNT/FOR MUD0:	!Mount the tape
SH DEV MUD0:	!Show the status of device MUD0:
DISMOUNT/NOUNLOAD MUD0:	!Rewind and dismount the tape to BOT without unloading

This will indicate the status of the drive and type the tape label and free space.

3. Backup to an archive tape

Select the appropriate directory to work from, unless you want to work from your home directory. Mount the previously initialised tape:

MOUNT/FOR MUD0:

The system will respond with:

%MOUNT-I-MOUNTED, (tapelabel) mounted on _GARP2$MUD0:

Backup your data:

BACKUP
FROM: (frend$disk:)[nsp#.dir]filename.dat
TO: MUD0:savesetname.BCK/NOASSIST/LABEL=(tapelabel)/BLOCK=64512

Or as one string:

BACKUP filename.dat MUD0:savesetname.BCK/NOASSIST/LABEL=(tapelabel)/BLOCK=64512

(Note: (frend$disk:)[nsp#.dir] may be omitted if the files are in the default directory. Full details must be included if you are working from another directory.)

ie.
BACKUP
FROM: FREND$DKA400[NSP1.S105]S105FXTM.DAT
TO: MUD0:DEC081993.BCK/NOASSIST/LABEL=SY0040/BLOCK=64512

Backup will take the file filename.dat or wildcards (*.*;*) from the working directory or the directory specified and will transfer the data in VMS Backup format to the square tape drive MUD0:. Backup stores the data into one file called savesetname.BCK. You must specify a unique save set name, perhaps the date (dec081993.bck) or the time (11121314.bck, as ARCHIVE utility does). /NOASSIST means that if there is a tape problem the system will prompt you at your terminal instead of the operator's terminal. /LABEL=tapelabel checks the tape header for the correct label and will notify any errors. /BLOCK=64512 blocks the data onto the tape (512x126 records).

Rewind and dismount the tape:

DISMOUNT/NOUNLOAD MUD0:

Once Backup has completed the task, the tape must be verified. It is relatively easy to check the contents of any saveset on tape:

MOUNT/FOR MUD0:
BACKUP/LIST[=filename.txt] MUD0:

The system will read the saveset header and print details of the saveset either on the screen or as a text file if you specify a filename after /LIST. The filename will be written to the current directory unless you specify another.

It is possible to archive more than one saveset to a tape. Backup will search through the tape to find the EOF of the previous saveset and will then write the next saveset. To read the header of subsequent savesets on a tape, the BACKUP/LIST MUD0: command must be repeated, such:

MOUNT/FOR MUD0:
BACKUP/LIST[=filename1.txt] MUD0:
%Listing file details of saveset backup01.bck etc, etc
BACKUP/LIST[=filename2.text] MUD0:
%Listing file details of saveset backup02.bck etc, etc
BACKUP.... etc

The tape will pause after each saveset header is read. You must prompt for more headers if there is more than one saveset on a tape.

4. Anticipated errors

Wrong tape label. Either get the correct tape, or re-initialise the tape if you have accidentally mislabeled it.

Incomplete archiving. You have underestimated the size of the data files you are attempting to save to tape. A 3480 tape will hold between 160 and 170 mBytes of data, depending upon how it is blocked. A VAX block is 512 bytes. Go figure...

5. VAX format foreign tapes

When reading VAX format tapes from foreign institutions the following instructions may become useful:

MOUNT/OVER=ID MUA0:	!mount the tape on MUA0: and automatically sense block size
COPY MUA0:*.* *.*/LOG	!copy all files on the tape and log the file names

6. Backup from VAX disk to dat tape

A backup will have to be done every time the program directory, UK and TI databases are replaced on board the ship. To backup files to a tape, a command sequence is shown below, using the program directory tree as an example. At the time of writing, the backup drive on board the ship was a 'dat' drive (dub2:).

$ INIT/OVER=(ACCESS,EXP,OWN) *tapedrive*: *saveset*	!initialise new saveset
$ MOUNT/FOREIGN/NOASSIST *tapedrive*:	!mount the dat tape
$ BACKUP APPL$SOFT:[NSP$SOFT...]*.* *tapedrive*:*saveset*.BCK/SAV	!backup file set
$ DISMOUNT/NOUNLOAD *tapedrive*:	!unload
$ BACKUP/LIST=*saveset*.LOG *tapedrive*:	!list contents of tape

To recover the data back onto disk, change directory to the required location and restore the file structure from that point down with the following commands:

$ MOUNT/FOREIGN *tapedrive* (Optional)	!mount the dat tape
$ BACKUP/LOG *tapedrive*:*saveset*.BCK/SAV disk:[*...]*.*;*	!restore file structure
$ DISMOUNT *tapedrive*:	!unload

9. Unix Applications

AWK

ASCII files can be exported via the "ftp" command to a Unix operating system for various uses such as manipulating data fields or reformatting output records. Once completed, the altered file can be imported back to the VAX. The Unix program used is **awk**, usage:

1. **awk -f fname filename,** where fname is a pattern instruction file and filename is the name of the file to be operated on.

2. **awk '/pattern/ {action}' filename**

awk is a line-by-line-pattern-matching language designed to be able to recognise patterns in a string or line and output these patterns (or pre-defined fields) in a user-specified format. The primary reference is The Awk Programming Language (Aho, Kernighan & Weinberger, 1988). A few of the more basic applications will be covered in the following paragraphs.

awk is defined by a pattern part and an action part which is always enclosed within braces {...}. The pattern part may sometimes be delimited by forward slashes /.../. If an action part is not specified, the default action is to print the whole of the line which has been matched with the pattern provided. At the time a line is read into the program, field variables are automatically stored. These are $0, $1, $2,..., where $0 contains the record, $1 the first field, $2 the second field and so on. Other in-built variables store the number of fields in the record, the current record number and the name of the file. If the command:

awk '$1 ~ /^[0-9]/ {print $2"   "$1}' s160fn.asc

was run, the program would read each line of file s160fn.asc and match each line whose first character of the first field contained a digit and then print out the second field followed by the first field separated by three spaces for these matched lines. The character ~ represents "contains" and **!~** represents "does not contain". **!** is the negation operator. The characters inside the pair of double quotes are inserted literally into the output string. When put together in this way the output is a concatenation of field1, three spaces and field2. If commas had been used to separate the $1 and $2 variables the output would have been field1, space, field2 as the default field separator is a space.

Inside the pattern slashes /.../, a number of characters, known as metacharacters have some specific properties. The class of metacharacters are []*?\.^$+.

The ^ symbol defines the start of a pattern or line, **$** the end of a pattern or line, [...] a character or number range, ***** none or more repetitions of the character string preceding it, **+** at least one repetition of the character string preceding it and **.** any single character. A backslash, \, which precedes a metacharacter nullifies its special significance when inside the pattern matching operator. The backslash may be used to negate its own meaning when double backslashes are used.

If a more specific output format is required, an awk reference should be consulted which discusses the formatted print statements **printf** and **sprintf**. These commands are similar to the C program language.

TAR

tar is the unix tape archive command and may be used to copy data to any output device such as an exabyte, 3480 or dat tape drive. The general form for the command is:

tar key[options] [file-list]

A typical command to backup a file to tar format is the following:

tar cvf /dev/rst0 [file1 file2 ....]

where the **c** option creates a new tape (and overwrites anything which may have already been on the tape), **v** provides a verbose listing of the files transferred and **f** is the filename of the device. In this case /dev/rst0 is the device name and **file-list** contains the file(s) to be copied.

To retrieve data from a tape to a disk type:

tar xvf /dev/rst0

where **x** is the extract option. All files on the tape will be reinstated in the current working directory when no file-list is specified (as above). Other options which may be used are: **w** (query) which confirms whether to read or write the file list.

GREP

grep is a command which simply searches for a pattern in a file line by line and when it finds a match, prints the whole line. **grep** is generally used as follows:

grep [options] pattern [file-list]

Options used include **i** ignore case, **l** only list the name of the file that contains one or more matches, **v** only outputs lines not containing a match.

10. Program Instructions

The non-graphics VMS programs in the NSP system perform automatic or semi-automatic manipulation of the data. The programs require only a VT220 (or superior) text terminal and can even be run via a modem connection. All these programs can be run interactively or in batch mode.

When a menu-driven program is started up, the initial option selections displayed are determined according to a system of **answer files**. The answer files are text files read by the program when it starts up. There is a path that each executing program takes to determine which answer file should be read. If the user enters the name of the program that is to be run followed by the name of an answer file (with or without the .ANS extension) the program will look for the answer file first in the current directory and then, if it is not found, in the user's login directory. If an answer file is not passed as a parameter, the program looks for an answer file with the same name as the program, first in the user's login directory and then in the global answer file directory.

This chapter covers the important menu-driven programs that are used for processing as well as the most used data extraction, post-processing, checking and display programs. For information about other available NSP programs, refer to Chapter 11, Miscellaneous Programs.

ANOM

Purpose: Given a channel of magnetic data, produce a channel of IGRF or AGRF magnetic anomaly data. Given a channel of gravity data, produce a channel of bouguer or free-air gravity anomaly data.

Command: ANOM *[AnswerFile]*

Screen:

```
                                    A N O M
                                                       +-------- TEST.DAT--------+
                                                       |Survey No.: 104          |
                                                       |No. Records:    5064     |
                                                       |Record Length: 10        |
                                                       |Sample Interval: 10      |
                                                       |Range: 268 161800        |
                                                       |       269 062220        |
                                                       +-------------------------+

+----------------- ANOM Options ------------------+
| Output file: S187AN.DAT                          |
| Latitude channel:  3                             |
| Mag channels - total: 7 anom: 8 Year: 1997  IGRF |
| Gravity channels - total: 6 faa: 9  ba: 0        |
|  Water depth channel: 5                          |
|  Density for BA calculation: 0.00                |
| Isogal84                                         |
+--------------------------------------------------+

+--------------------------------Messages---------------------------------+
|                                                                         |
+-------------------------------------------------------------------------+
```

How ANOM works:

ANOM reads a binary file containing final geophysical data and creates an output file containing the original geophysical data channels as well as anomaly data in output channels specified by the user.

Notes:

- When using this program to convert full-field gravity and magnetics data into anomaly form for entry into the MARDAT database, the final channel allocations for data should be total gravity (6), total magnetics (7), IGRF anomaly (8) and free-air gravity anomaly (9).

- When computing the bouguer anomaly, the final water depth channel and density must be supplied. Bouguer anomaly data should only be produced upon request and should not be computed when the output file is to be placed into the time-based database.

CABLE

Purpose: To convert dx/dy values for compass values to lat/long values.

Command: CABLE *[AnswerFile]*

Screen:

```
                                   C A B L E

                                                  +--------S160SM.DAT--------+
                                                  |Survey No.: 160           |
                                                  |No. Records:  87468       |
                                                  |Record Length: 40         |
                                                  |Sample Interval: 10       |
                                                  |Range: 288 124500         |
                                                  |       349 063200         |
                                                  +--------------------------+

+------------------Cable Instructions-----------------+
| Output file    : cable.dat                          |
| Number of compasses :   5                           |
| Output lat channel  :  31                           |
| dGPS latitude channel:   3                          |
| Course channel      :  15                           |
| Heading channel     :  13                           |
| Tailbuoy lat channel:   6                           |
| MX100 lat channel   :   9                           |
| Start processing: 289 000000                        |
+-----------------------------------------------------+

+----------------------------------Messages------------------------------------+
|                                                                              |
+------------------------------------------------------------------------------+
```

How CABLE works:

CABLE computes and outputs the lat/long position of the compasses along a seismic streamer and the tailbuoy based on the dx, dy values (relative to the stern of the ship) computed by program COMPASS.

Notes:

- The output latitude channel specified in the menu is for compass 1. In the menu above, for example, the dx and dy values for compass 1 are read in channels 31 and 32 respectively. Compass 2 values are in channels 33 and 34 and so on up to channels 39 and 40 for compass 5. The corresponding lats and longs are output to the same channels.

- The MX100 correction was abandoned when it was discovered that the MX100 position (on the ship) and the tailbuoy position did not correlate well. This was thought to be due to a difference in the satellite configuration between the two systems at the instant of the measurement.

COMPASS

Purpose: To convert compass values (initially in degrees) to dx/dy values behind the ship for each compass.

Command: COMPASS *[answer_file_name]*

Screen:

```
                          C O M P A S S

                                                 +--------S167AN.DAT--------+
  +--------Streamer Geometry--------+            |Survey No.: 167           |
  | Number of front stretches:    1 |            |No. Records:  87468       |
  | Number of rear stretches :    1 |            |Record Length: 10         |
  | Number of seismic channels: 240 |            |Sample Interval: 10       |
  | Channel interval    :   12.50 m |            |Range: 288 124500         |
  | Energy source offset:   36.25 m |            |       349 063200         |
  | Source to channel 1 :   75.00 m |            +--------------------------+
  | Tail rope length    :   60.00 m |
  +---------------------------------+
+--------------------------Miscellaneous---------------------------+
| Output file: S160compass2.dat                                    |
| Number of compasses:   5                                         |
| Compass seismic channels:   5  73 137 185 233   0   0   0   0   0 |
| 1st compass data channel  :  23                                  |
| Delta_x channel compass 1 :  31                                  |
| Heading, course channels:  13  15                                |
| Antenna to stern:        51.2 m                                  |
| Start processing: 289 000000                                     |
| End processing  : 330 000000                                     |
| Print frequency : 36000 sec                                      |
+------------------------------------------------------------------+

+--------------------------------Messages----------------------------------+
|                                                                          |
+--------------------------------------------------------------------------+
```

How COMPASS works:

COMPASS computes and outputs the position of each of the compasses on a seismic streamer and the tailbuoy. The computation is made based upon the compass angle at each compass location and the known length of cable between each compass. The positions are represented by offsets in the in-line and cross-line directions of the ship, dx and dy.

Notes:

- Adapted from the seismic acquisition system's COMPASS, which computes the feather angle of the streamer from the streamer compass headings. The program generates a file containing the components of the distance to the compass, in metres, along and perpendicular to the ship's course.

- The output from this program is used as input into program CABLE to generate the geographical locations of the compasses.
- The program can take up to 10 compasses as input. The 'compass seismic channels' requires the seismic channel number that each compass is situated along the cable (normally between 1-240).
- In the example from the menu above, channels 31 and 32 will contain output dx and dy values respectively for the first compass. Channels 33 and 34 will contain the dx, dy values for the second compass and so on.

CRUX

Purpose: To compute intersections and misties.

Command: CRUX *[answer_file_name]*

Screen:

```
                              C R U X
                                           +-------- ARAFURA.DAT --------+
                                           | Survey No: 18               |
                                           | No. Records : 57894         |
                                           | Record Length : 8           |
                                           | Sample interval : 60        |
                                           | Range :   28 112900         |
                                           |        **** 002700          |
                                           +-----------------------------+
+--------------- CRUX Options -----------------+
| Output file : ARAFURA.ASC                    |
| Output directory : DKB700:[NSP3.TI.X]        |
| Channel 1 for misties (eg depth)    :   5    |
| Channel 2 for misties (eg gravity)  :   6    |
| Channel 3 for misties (eg magnetic):    7    |
| Latitude channel : 3                         |
| Maximum ship speed (kn)   : 10.0             |
| Terminate after first survey (Y/N)?: Y       |
| Write log (Y/N) : N                          |
+----------------------------------------------+

+---------------------------------Messages-----------------------------------+
|                                                                            |
+----------------------------------------------------------------------------+
```

How CRUX works:

The program reads each record of a binary file, storing the time, lat/long positions and geophysical data into an array. The program works by reading the start/stop positions of two adjacent points as a segment A and tests each possible segment B in the remainder of the array for whether or not the two segments intersect. Once the last segB is reached, the program then reads the next segA of the array and starts looping from the first segB. In order to speed up the program, after each test (within one segA loop), the distance between segA and segB is calculated and a minimum time computed based on a maximum possible speed of the ship. This enables the program to skip through the equivalent number of records, knowing that there cannot possibly be an intersection. As each intersection point is found, the times for both segments are output to a file along with the misties for each geophysical data type.

Notes:

CRUX will only work with <u>final</u> processed navigation data. It is only to be used on 1-minute files of 700,000[2] records or less and will work on files which contain time jumps.

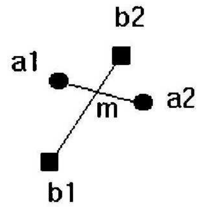
---

[2] The array size can be modified to accommodate the number of records in the input file.

CRUX produces a listing of intersection times, misties and some statistical information about the misties. The columns are laid out as follows:

```
 Intersection      Channel 5     Channel 6      Channel 7
TimeA    TimeB    Mis. %e 1/g  Mis. %e 1/g    Mis. %e 1/g
------------------------------------------------------------
```

TimeA and TimeB are the intersection times on the two legs of the ship's track. They are linearly interpolated from the adjacent 4 data records. In the diagram below, two legs of the ship's track are shown as circles (leg A) and squares (leg B).



The geophysical parameters at these 4 data records are also linearly interpolated to the intersection times and the difference between the interpolated values gives the mistie. In the diagram, the two values on leg A are a_1 and a_2. These are interpolated to the intersection point to give an interpolated value on leg A of a_i. Similarly on leg B we have an interpolated value at the intersection point of b_i. The mistie is then computed as $m = a_i - b_i$. If the mistie is positive, then the interpolated value derived from leg A is greater than the value derived from leg B.

The column headed `%e` is the ratio of $2m/(a_i + b_i)$ expressed as a percentage, ie the size of the mistie compared to the mean of the interpolated values. The column headed `1/g` is the reciprocal of the mean gradient of the geophysical parameters at the intersection point. A small number here indicates a steep gradient in the vicinity of the intersection.

Use the program MSTATS to obtain mean and standard deviation of the data in CRUX output listing.

In specifying the minimum and maximum ship speeds, please note the following:

- The maximum ship speed is used to optimise the speed of execution. The program actually triples the figure entered via the menu to ensure all intersections are picked up. For a quick pass which may skip some intersections, a figure less than 10 knots (kn) may be used.

- At low ship speeds, the noise in the position data leads to the generation of many spurious intersections. A minimum ship speed of about 1 kn seems to get around this problem.

The log file gives the same information as the output file and so is not necessary. See [NSP3.TI.X] for some examples of CRUX output.

DELAY

Purpose: Apply a delay to the shot times file to give the time at which the ship's antenna was at the Seismic Stack Point (SSP).

Command: DELAY *[answer_file_name]*

Screen:

```
                                  D E L A Y

                                                    +------ S127PD.DAT -------+
                                                    |Survey No.: 127          |
                                                    |No. Records:  41027      |
                                                    |Record Length: 15        |
                                                    |Sample Interval: 60      |
                                                    |Range: 117 090300        |
                                                    |       145 194900        |
                                                    +-------------------------+
+--------------- DELAY Specifications ----------------+
| Shot times file (input) : S127ST.ASC                |
| Shot times file (output) : S127STD.ASC              |
| Near offset file (input) : S127NO.ASC               |
| Latitude channel :   3                              |
| Speed Window     :  60 secs                         |
| Print Frequency  : 1000 records                     |
| Format of shot times file : S                       |
| Shot interval range (sec) :    4.5   6.5            |
| Median or average speed   : A                       |
| Speed changes allowed     : 1.5 %                   |
| Position at source (Y/N)? : Y                       |
| Write log (Y/N) : Y                                 |
+-----------------------------------------------------+

+--------------------------------Messages-----------------------------------+
|                                                                           |
+---------------------------------------------------------------------------+
```

How DELAY works:

The shot times file is used to compute the position of the ship's antenna at the time of the shot. Because the antenna is offset from the point at which the position is needed, eg. normally either at the source or at the common mid-point, one way to get the correct position is to apply a delay to the shot time. This delay should represent the time it took the antenna to travel from the SSP to its location at the instant the shot went off. The time at the SSP is then used to interpolate the position at the SSP from the time-based navigation file. An advantage of doing it via this method is that geophysical data can later be extracted (by interpolation) at the corresponding time at the SSP.

Notes:

- To compute the time delay, the program requires the ship's speed and the distance from the antenna to the SSP.
- The program computes the ship's speed from the final navigation data file and requires that you specify a speed window. The speed used in the computation should be the mean speed over the distance antenna to SSP, so a window of about 70 seconds is appropriate.
- There are two ways DELAY can compute speed, by either the Average or Median methods. The methods give similar results. Average uses the distance travelled over the window and divides by the time. Median uses the mean of all but the highest and lowest sample-to-sample speeds within the window. It has been found that 10-second data gives better results than 1-minute data.
- DELAY can apply a brake to speed variations and is specified as a percentage change from the previous computed value. A figure of 1.5% works well and is probably the minimum value that should be used, as real speed variations are less than this. If the change in speed is more than 1.5% of the previous speed, then new speed = 101.5% x previous speed.
- The program accepts the antenna to SSP distance in two parts via a near-offset control file. The distance from antenna to centre of source (source offset) is fixed for the duration of the survey and the distance from the source to the centre of channel 1 (near offset) may change during the survey. The control file has a record for each near-offset change, with line-name, shot number, near offset and antenna-source distance given as (A10, I6, F6.1, F6.2). Each line-name and shot number must exist in the shot times input file.
- The navigation may be positioned at the source by setting it in the menu. When invoked, the program will override the near-offset value (in the control file) to zero.
- There have been several formats for the shot times file and this has caused some confusion. DELAY accepts a shot times file in the format as written in the field, known as "Ship" format. This format contains line name, shot number, day, hhmmss and 2 digits for hundredths of second (x, A10, I6, x, I3, x, I6, I2).
- The output format is identical to the input format, but has additional diagnostic fields. These are: difference between consecutive DELAYed shot times, old shot time, difference between consecutive old shot times. UKOUT will ignore these diagnostic fields.
- The shot interval range is merely for checking shot intervals and is not used in the computation. Shot intervals outside the given range are reported to the screen and log file.

DIGIT

Purpose: Digitise EPC water depth records

Command: DIGIT

Setting up for Digit:

Add the following lines to your *login.com* file (for digitising in the office):

```
$ assign tt digitizer
$ assign digitizer dci_digitizer
$ assign/user sys$command sys$input
```

Go to the terminal connected to the digitiser and log on. If you are already logged on, execute your *login.com* file with

```
$ @login
```

Starting DIGIT:

Go to your working directory and start DIGIT

$ set def *working_directory*
$ digit

DIGIT will prompt you for the survey number and the name of an output file.

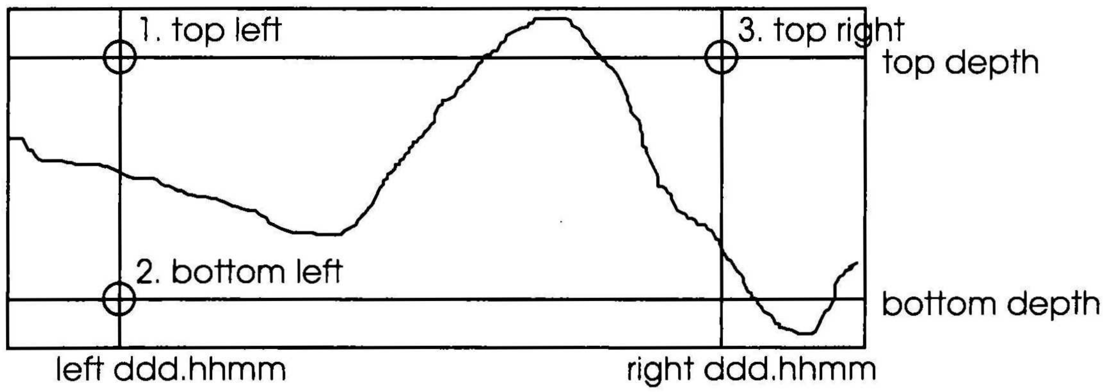
Setting up the Coordinate System:

Lay the EPC roll out onto the horizontal digitising table.

Identify 3 points to define the coordinate system for the first section. The 3 points, in the order in which they will be digitised are:

1. top left
2. bottom left
3. top right

DIGIT will ask you to key in the depth for *top depth* and *bottom depth*, then the time for *left ddd.hhmm* and *right ddd.hhmm*. The 3 reference points and the lines which define them are shown in the diagram below:



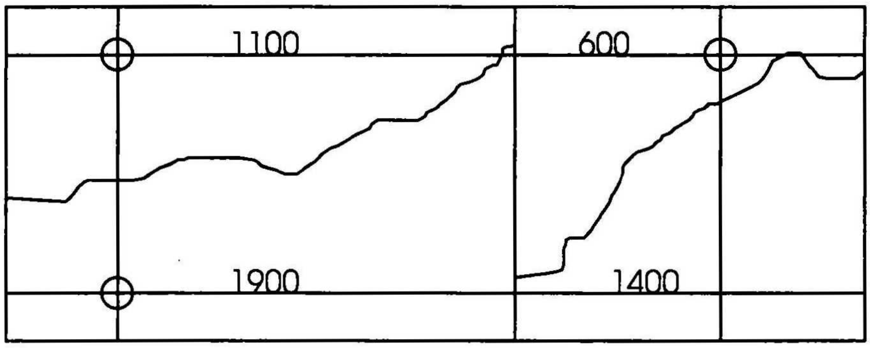
As implied in the diagram, you don't have to limit your digitisation to the area within the rectangle defined by points 1, 2 and 3. You can digitise beyond the limits of left ddd.hhmm and right ddd.hhmm, as long as the paper speed remains constant throughout. If the paper speed changes, you will have to start a new section and define the reference points again.

After the reference points have been defined, DIGIT will prompt you to commence digitising. Use the "4" or "5" key on the cursor to enter a point into your output file.

- Note: If you intend using the skeleton file on a one minute file, do not digitise more than one point within each one minute interval (ie: < 1 cm between points), otherwise the SALVG output will be garbage.

Changing the Depth Scale:

Often, while digitising a section, you will encounter a depth scale change, as in the following diagram where the chart range changes from 1000-2000 to 500-1500.



When you arrive at the time at which the depth scale changes, press "9"on the cursor keypad and you will be prompted to enter the new *top depth* and *bottom depth* at the keyboard. Continue digitisation after changing the depth scale.

Changing the Time Scale:

When the paper is moved, or when there is a change in paper speed, a new section must be commenced. Do this by moving the paper to the new position, if it needs to be moved and then type the "#" key on the cursor keypad.

DIGIT will bring up a menu and choosing "2" on the cursor keypad will bring up the prompt for resetting the time and depth scales. Then follow the procedure as explained in *Setting up the Coordinate System* above.

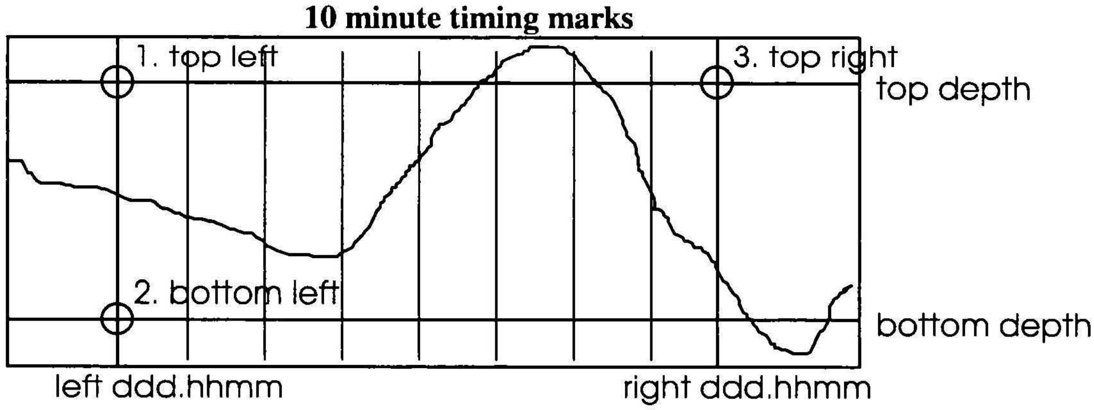
Other Options:

The "#" key also brings up other options, these being:

1) Next Section (Reset Time Scale Only)
2) Next Section (Reset Time and Depth Scales)
3) Add a Comment to the file
4) Continue digitising current section
5) End Program

An option exists within DIGIT to digitise each 10-minute mark as well as the 3 reference points. This was introduced to reduce the cumulative effect of subtle changes in paper speed on the digitised times over the time range bounded by the reference points. The method involves digitising the following three types of data on the EPC charts: 1) The 3 reference points 2) Each 10-minute mark between the reference points only and 3) Water-depth values. Each 10-minute mark should be digitised at the point where the 10-minute timing mark intersects the reference line (top depth line in diagram).

10 minute timing marks



An interpolation of the time is carried out within each 10-minute slice instead of between the reference points, thus reducing any cumulative timing errors which may be present due to a subtle, slowly-varying paper speed. This option should be used when providing water depths to clients for seismic surveys and has been prompted by the necessity to more exactly determine the shotpoint location of the edges of reefs and sea-mounts etc which are important to know for the application of seismic statics during seismic processing. When choosing this option, best results are obtained by digitising all points as precisely as possible. Even after this there is still some residual error of the order of 10 seconds[3] due to other factors (thickness of timing lines, slight warps in the paper, timing lines not precisely orthogonal to the direction of movement of the paper etc), however this is as accurate as can be expected.

[3] For paper moving at a speed of 2.75cm per 10 minutes.

EÖTVÖS

Purpose: Tie the gravity to datum; adjust the gravity channel for drift and the Eötvös correction (Centrifugal force of the Earth's rotation).

Command: EÖTVÖS *[AnswerFile]*

Screen:

```
                              E O T V O S
                                              +---- S098FD.DAT  --------+
                                              |Survey No.:  98          |
                                              |No. Records:   8103      |
                                              |Record Length: 10        |
                                              |Sample Interval: 10      |
                                              |Range:  39 125510        |
                                              |        40 112530        |
                                              +-------------------------+
+--------------------EOTVOS Options------------------+
| Output file: EOTVOS.DAT                             |
| Final Nav. Channels:  7  8                          |
| Gravity Channels    : 10 11                         |
| First  meter zero reading: 039 220000   9800000.00  |
| Second meter zero reading: 040 200000   9790000.00  |
| Eotvos Output channel  : 12                         |
| Apply Eotvos Correction: N                          |
+-----------------------------------------------------+
+-----------------------------------Messages-----------------------------------+
|                                                                              |
+------------------------------------------------------------------------------+
```

How EÖTVÖS works:

The program corrects for the effect of the east-west component of the ship's speed on the gravity readings. This has the effect of creating an apparent quickening or slowing of the earth's rotation. This processing step corrects the gravity data as it would appear if the east-west speed component of the ship was zero (in equilibrium). The program outputs the corrected gravity and has an option to output the correction. It also has an option allowing the user to apply the gravity ties, thus representing the gravity data as full field values (in units of $\mu m/s^2$). In this option, the program accepts the meter zero full-field gravity values at two times - one before and one after the survey - and assumes a linear drift in the meter.

Notes :

- All gravity values should be in $\mu m/s^2$.
- The user has an option on whether or not to apply the Eötvös correction. The correction may be applied in one pass and the gravity tie done separately. **Note:** If done in this way, the user must ensure that the correction is only applied once.

FDATA

Purpose: De-spike data using a SUM-DIFF filter.

Command: FDATA *[AnswerFile]*

Screen:

```
                              F D A T A
                                                   +------- SPIKE.DAT--------+
                                                   |Survey No.: 102          |
                                                   |No. Records:    1824     |
                                                   |Record Length:  4        |
                                                   |Sample Interval: 10      |
                                                   |Range: 167 185840        |
+--------------FDATA Options--------------+        |       168 000230        |
| Output data file: DESPIKED.DAT          |        +-------------------------+
| Frequency of reports(mins): 240         |
|    3   4  12      7.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
|    0   0   0      0.00000000            |
+-----------------------------------------+
+-----------------------------------Messages----------------------------------+
|                                                                             |
+-----------------------------------------------------------------------------+
```

How FDATA works:

FDATA uses a sum-difference filter to de-spike data which works as follows: 1) the differences within a window around a point are calculated 2) the average of these differences are calculated for each point and 3) the average differences, along with the values, around a point are used to determine if the point is a spike.

Notes:

- The de-spiked data is written to a spare channel. In the above example, channel 3 is de-spiked and placed in channel 4. A window length of 12 and a tolerance of 7.0 is used.
- The number of spikes removed is reported at the frequency specified.
- For reasonable quality 10 sec navigation data, it is recommended that a 3-5 record window with a threshold of 1.5e-06 radians (9 metres) be used.

FINAV

Purpose: Produce a final navigation pair of channels (ie. latitude & longitude) from mixing or selecting from up to 5 navigation pairs. Adjust the chosen gravity channel for drift and the Eötvös correction (Centrifugal force of the Earth's rotation).

Command: FINAV *[AnswerFile]*

Screen:

```
                              F I N A V

                                              +------- MATHS.DAT--------+
                                              |Survey No.:  99          |
                                              |No. Records:    8103     |
                                              |Record Length: 10        |
                                              |Sample Interval: 10      |
                                              |Range:  39 125510        |
                                              |        40 112530        |
                                              +-------------------------+

+-------------------FINAV Options-------------------+
| Output file: FINAV.DAT                            |
| Directives file: FINAV.FNV                        |
| Final Nav. Channels:  7  8                        |
| Gravity Channels: 10 11                           |
| First  meter zero reading: 038 220000   9800000.00 |
| Second meter zero reading: 040 200000   9790000.00 |
| Eotvos Output channel:  0                         |
+---------------------------------------------------+

+---------------------------------Messages-----------------------------------+
|                                                                            |
+----------------------------------------------------------------------------+
```

How FINAV works:

FINAV is the original program on which program EOTVOS is based. See the section on program EOTVOS for details.

Directives File:

An example directives file for the above screen follows:

```
! FINAV.FNV - ftape.dat -> finav.dat

! Navigation Channel Pairs:
NAV      3 4  5 6

! All the way through the file.
39 145000  1   0
39 145100  0   1
39 183030  0   1
39 183130  1   1
```

The first non-comment line must specify the navigation channel pairs to use to produce the final navigation pair. There can be up to 5 navigation pairs specified. The remaining non-comment lines specify start times and the weighting of the chosen navigation channels to apply to produce the final navigation.

As can be noted from the above example, the first and last times specified in the directives file do not need to correspond to the first and last times of the data file. In the above example the following weights are applied:

Day39 Time125510 (beginning of file) to Day39 Time145000
- take 3,4 as the final nav channels

Day39 Time145000 to Day39 Time145100 - change linearly from 3,4 to 5,6

Day39 Time145100 to Day39 Time183030 - take 5,6 as the final nav channels

Day39 Time183030 to Day39 Time183130 - change linearly from 5,6 to a 50/50 mixture of 3,4 & 5,6

Day39 Time183130 to Day40 Time112530 (end of file)
- take 50/50 mixture of 3,4 & 5,6 as the final nav channels

ADDITIONAL NOTES

* All gravity values should be in $\mu m/s^2$.
* The navigation channels specified in the directives file are used to calculate absolute gravity corrections.

FIXTM

Purpose: Fix time gaps and overlaps in a data file.

Command: FIXTM *[AnswerFile]*

Screen:

```
                                F I X T M

                                                 +-------- MAG.DAT---------+
                                                 |Survey No.: 106          |
                                                 |No. Records:    8609     |
                                                 |Record Length:  4        |
                                                 |Sample Interval: 10      |
                                                 |Range: 332 110920        |
                                                 |       333 110400        |
+------------FIXTM Specifications------------+   +-------------------------+
| Output data file: FIXTM.DAT                |
| Time correction file:                      |
| Range to work on (records):      1  8609   |
| Sample interval (secs) of file:   10       |
| Maximum interpolation interval(mins): 1440 |
| Display screen messages (Y/N)?: Y          |
+--------------------------------------------+

+----------------------------------Messages-----------------------------------+
|                                                                             |
+-----------------------------------------------------------------------------+
```

Notes:

- FIXTM corrects time jumps both automatically and according to specifications in the time correction file. Directives in the time specification file override corrections that would be otherwise done automatically. The automatic correction for time overlaps is to retain the first values in the overlap and discard the records with the repeated time values. The automatic correction for time gaps is to fill in the gap if it is less than the maximum interpolation interval (specified above).

- The 'range to work on' is also the range of data that is written to the output file. Thus <u>FIXTM can be used to copy part of one data file into a new data file.</u> Because the interval in FIXTM is specified by the beginning and end record number and usually an interval is known by its beginning and end time it will often be necessary to determine the record numbers by using either MLIST, LOOKTIME or the interactive graphics program, PCEDAT.

- The sample interval shown in the right top window is the time difference between the 1st and the 2nd record of the file. The user is asked to enter the sample interval just in case there happens to be a time jump between these 2 records causing this number to be wrong.

- FIXTM is used in conjunction with MLIST and STATS. Use MLIST to determine what time jumps are present and if necessary generate a time correction file. After running FIXTM, quickly run STATS to verify that all time jumps have been corrected.

Time Correction File:

This should be named with the extension, .FXT. An example follows:

```
! TEST.FXT - CORRECTION FILE for test.dat -> fixtm.dat

PAD       86      87

! delete (skip) 4 records - 189,190,191,192
SKIP      189     192

! survey number was wrong at record 287
CORRECT   287     287       104.268     170610

! day was wrong about record 305
CORRECT   304     310       104.268     170900
```

- Comment lines (starting with !) and blank lines are allowed.
- With all directives, the first number (eg. 86 & 189 above) must start at column 8 or more.
- PAD 86 87 means pad the time gap between records 86 & 87.
- SKIP 189 192 means delete records 189 to 192 inclusive.
- CORRECT 304 310 104.268 170900 means replace the time values between records 304 and 310 inclusive with times starting with survey 104, day 268, 17 hours, 9 mins, 0 seconds and incrementing with the sample interval of the file (often 10 seconds).

FTAPE

Purpose: Blank out bad magnetics data and bad Raytheon data. Blank out data values for specified channels over specified intervals. For specified channels, treat values above a chosen limit as blank and straight line interpolate ('Fill') across the gap (providing the gap is not too wide).

Command: FTAPE *[AnswerFile]*

Screen:

```
                                F T A P E

                +---------FILL Channels---------+
                |  5          3.0000000000  |          +------- SURV99.DAT-------+
                |  6          3.0000000000  |          |Survey No.:  99          |
                |  0          0.0000000000  |          |No. Records:  10445      |
                |  0          0.0000000000  |          |Record Length: 10        |
                |  0          0.0000000000  |          |Sample Interval: 10      |
                |  0          0.0000000000  |          |Range:   39 125510       |
                |  0          0.0000000000  |          |         40 175550       |
+------------FTAPE Main Menu-------------+0  |          +-------------------------+
| Output data file: FTAPE.DAT          . |0  |
| Reporting freq (mins):   60            |0  |
| DELETE specs. file: S99.FTP            |0  |
| Raytheon channels:    7   8            |0  |
| Mag. channels:     9   0               |0  |
+----------------------------------------+0  |
                |  0          0.0000000000  |
                |  0          0.0000000000  |
                |  0          0.0000000000  |
                |  0          0.0000000000  |
                |  0          0.0000000000  |
                |  0          0.0000000000  |
+---------------| Max. gap to span:  60.0 mins. |---------------------------------+
|               +-------------------------------+                                 |
+---------------------------------------------------------------------------------+
```

Warning: **Do not perform more than one operation on any channel during a run of the program.**

Notes:

- The results of the operations are reported at the frequency specified.
- Data in the FILL channels are considered to be blank if they are above the value specified. If data gaps defined in this way are narrower than the 'Max. gap to span', a straight-line interpolation is done across the gap. If the gap is too wide the values are left as is.
- Bad magnetic data is considered to be any where the mag value repeats itself for at least 3 consecutive values. These values are replaced by 10^{10} values until the mag value changes. (A constant value is written to tape when the magnetometer is switched off onboard the ship.)

Delete Specs File:

This should be named with the extension, .FTP. An example follows:

```
! S99.FTP - Survey 99  Spec. file for DELETE routine in FTAPE

 039  230200   039  231900      3  4
 039  234000   039  234500      3  4
 040  113200   040  114100      3  4
 040  225100   040  233000      3  4
 041  101000   041  101300      3  4
```

- Comment lines (starting with !) and blank lines are allowed anywhere in the file.
- The 3rd line of the above example means for the interval - day# 39, 23 hours, 2 mins to day 39, 23 hours,19 mins (inclusive) blank out the values in channels 3 & 4.
- Up to 10 channels can be specified at the end of each directive line. (Only 2 channels - 3 & 4 - are specified in the above example.)

GDAT

Purpose: To extract data from the digital database.

Command: GDAT *[AnswerFile]*

Screen:

```
                              G D A T

+-------------------- GDAT Options ------------------------+
| Include CMS data          : Y                            |
| Include CMP data          : Y                            |
| Include OTMP data         : Y                            |
| Include OTHER data        : Y                            |
| Include CONTRACT data     : N                            |
| Include FOREIGN data      : N                            |
| Include TRIPARTITE data : N                              |
| Include NGDC data         : N                            |
| Include SEISMIC surveys       : Y                        |
| Include NON-SEISMIC surveys : Y                          |
| Polygon File       : MENU                                |
| Bounding rectangle : -36  0 -42  0 134  0 144  0         |
| Sample frequency (min) :   10                            |
| Exclude :  17   0   0   0   0   0   0   0   0   0   0   0 |
| Include :   3   5   0   0   0   0   0   0   0   0   0   0 |
+----------------------------------------------------------
       +---------------- I/O Files-----------------------+
       | Start/Stop Times file  : PROCLIM.ASC            |
       | Survey Definition file : SURVDEF.ASC            |
       | Write Log : N                                   |
       +-------------------------------------------------+
                              +------ Output channels ----------+
                              | Number of output channels  : 8  |
                              | Water Depth               :  5  |
                              |   matthews correction     :  Y  |
                              | Gravity field             :  6  |
                              | Total Magnetic field      :  7  |
                              | Bouguer anomaly           :  0  |
                              |   density for BA (g/cc) :  2.20 |
                              | Free air anomaly          :  0  |
                              | Residual Magnetic field :    8  |
                              +---------------------------------+

+---------------------------- Messages ---------------------------------+
|                                                                       |
+-----------------------------------------------------------------------+
```

How GDAT works:

GDAT extracts data from the time-indexed digital database according to criteria specified in the "gdat options" menu. The "output channels" menu specifies the geophysical parameters output requirements. The program only searches those files which fit the criteria specified and contain the relevant geophysical parameters.

The program uses a survey definition file to decide whether the criteria are met and whether the file contains the required data. This survey definition file is given in the "I/O files" menu. The definitive survey definition file is in the same directory as the data files and is called *SURVDEF.ASC.*

GDAT also only extracts data that lies within the time intervals specified in the start/stop times file. There are two of these files in the database directory. *PROCLIM.ASC* gives the processing limits for the digital database. It has become necessary to include this control file after the policy of processing *all* data was dropped. *SEISLIN.ASC* gives the time limits of the seismic lines which have been processed.

GDAT can be used normally to search the database in a rectangular area, or to either extract or omit all data within a user-specified (closed) polygon. If the normal search is required, type MENU at the polygon file option. Otherwise type the name of the file containing the geographical location of the vertices of the polygon (in decimal degrees). The format of this file is (x, 2f11.7) with the lat and long order being interchangeable. When specifying the vertices, they must be included in clockwise or anti-clockwise order. There is no need to close the polygon by making the last point equal to the first point, the program will assume that it is closed. When specifying the polygon option, ensure that the outer rectangle search area fully contains the area bounded by the polygon. Below is an example of a polygon file. Lines can be commented by placing a '*' in column 1.

```
*Instruction                    ! either INSIDE (to limit data within polygon) or OUTSIDE
 -12.000000 135.000000
 -12.500000 135.500000
 -13.000000 135.000000
 -12.500000 134.500000
```

Notes:

- If a survey number appears in the "include list", the file will be searched regardless of any other settings, even if it is also in the "exclude list". If a survey is in the "exclude list" and not in the "include list", it will not be searched.

- There are 8 mutually exclusive sets of surveys at present. These are:

CMS	Continental Margins Survey
CMP	Continental Margins Program
OTMP	Ocean Territories Mapping Program
OTHER	Other AGSO surveys
CONTRACT	Surveys shot by AGSO on contract to an external client (confidential)
FOREIGN	Foreign
TRIPARTITE	Tripartite
NGDC	National Geographical Data Center (US)

  Thus, at least one of these must be set to 'Y'.

- There are only 2 types of surveys, seismic and non-seismic. The latter are generally geology cruises and cruises from which there are no seismic products. Thus, at least 1 of these must be set to 'Y'.

- If no output channels are specified for the geophysical field parameters, then GDAT returns navigation data only. If one or more of the geophysical parameters are specified, a record is extracted if and only if it contains a value for any one of those parameters.

- The logical hierarchy for passing a survey file for record-by-record searching is :

  - is the survey file in the include list? (absolute)
  - does the survey belong to the required set?
  - is the survey of the required type?
  - does the survey contain the required parameters?
  - does survey boundary overlap required rectangle?

IGPS

Purpose: Interpolate Racal #1 and Racal #2 positions, which were computed at their respective fix times, to the DAS time.

Command: IGPS *[AnswerFile]*

Screen:

```
                                  I G P S

                                                      +-------- S119TR.DAT -----+
                                                      |Survey No.: 119          |
                                                      |No. Records:   235064    |
                                                      |Record Length: 12        |
                                                      |Sample Interval: 10      |
                                                      |Range: 168 161800        |
+---------- IGPS Specifications-------------+         |       269 062220        |
| Output data file: S119IG.DAT         .    |         +-------------------------+
| Start time for correction : 168 161800    |
| Stop time for corrections : 269 062200    |
| Latitude input and output channels : 5  9 |
| GPS record time channel            : 7    |
| Record time - fix time channel     : 8    |
| Log frequency (records)   : 1000          |
| Write to log file         : N             |
+-------------------------------------------+

+-----------------------------------Messages------------------------------------+
|                                                                               |
+-------------------------------------------------------------------------------+
```

How IGPS works:

The Racal dGPS system outputs a data stream via its AUXCOM3 port, which goes to the VAX DAS computer. Several fields are stripped from the data stream and stored in the DAS output buffers for real-time navigation and post-processing.

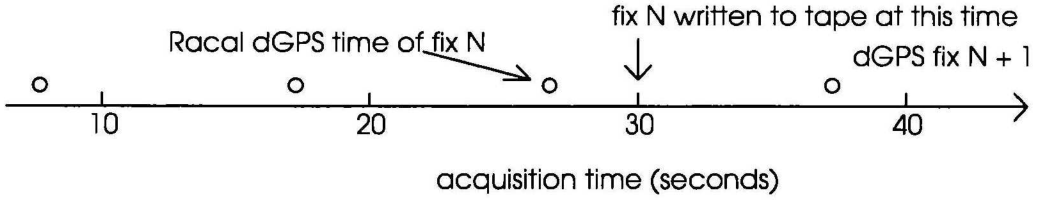
The Racal data stream is sent to the DAS computer once per second. It is picked up by a program and the required fields are stripped from the data stream and placed into a buffer. Each time a new data stream arrives from the Racal computer it overwrites the old data in the buffer.

Every second the DAS computer runs the main acquisition program which strips the latest data from the various buffers and places it into the main input buffer.

After the main acquisition program has completed its cycle the processing program runs. It strips the data from the input buffer, processes it and places it into the output buffer from where it goes to magnetic tape.

The Racal system outputs a position and "time of record". The "time of record" is about 1.5 - 2.0 sec after the time of the position fix. The problem that has shown up is a delay in the Racal system obtaining its data. When the optical disks become about 75% full the system begins to hang for relatively long periods while it is attempting to write data to the disk. This delay has been up to 7-8 seconds. During that period the GPS monitor screen freezes and it appears that not only is data not output via the AUXCOM3 port but it is not even being collected. By looking at the data from the magnetic tapes for the times when the system was clogging up, it can be seen that there are periods when the data accepted by the DAS computer has been 7-8 seconds before the expected time. This has occurred because the data in the buffer that is read by the acquisition program is not being updated every second. The DAS program simply has taken the current buffer values. The effect this has on the positions is to give very noisy data.

For the purposes of the real-time systems, the best estimate positions are extrapolated from the delayed data. In processing the data in the office, if one is going to use position data from Racal #1 or Racal #2 channels, then a similar correction has to be applied first. However, instead of extrapolating, IGPS does an interpolation between values either side of the 10-second time.



The diagram above illustrates the problem. IGPS interpolates between the positions computed at fix N and fix N+1 and writes the result to the record at time 30 seconds. However the best estimate positions for time 30 sec is computed in the field by taking the positions from fix N and fix N - 1 and extrapolating to a position at time 30 seconds.

MATHS

Purpose: Add or multiply channels by specified factors. Produce a channel that is the difference between successive values in another channel (multiplied by a factor).

Command: MATHS *[AnswerFile]*

Screen:

```
                                   M A T H S

                                                        +------- FTAPE.DAT--------+
                                                        |Survey No.:  99          |
                                                        |No. Records:  10445      |
                                                        |Record Length: 10        |
                                                        |Sample Interval: 10      |
                                                        |Range:  39 125510        |
+----------Maths Specifications-----------+             |        40 175550        |
| Output data file: MATHS.DAT             |             +-------------------------+
| Frequency of reports(mins):  60         |
| Start time :  39 125510                 |
| Stop  time :  40 175550                 |
| MULT   4            0.20000000          |
| DIFF   5            1.00000000          |
| ADD    6            4.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
|        0            0.00000000          |
+-----------------------------------------+

+-----------------------------------Messages-----------------------------------+
|                                                                              |
+------------------------------------------------------------------------------+
```

How MATHS works:

MATHS works by performing a user-selected mathematical operation on specified channels in a binary data file and replacing the values in each of these channels with the values after the operation.

Notes:

- A sample of the results is reported at the frequency specified.
- The options are the main arithmetic operations MULT, ADD and MOD. The DIFF option will multiply the factor by the difference between the current and previous value.

MERGE

Purpose: Merge up to 10 channels from one file into another over a specified period of time.

Command: MERGE *[AnswerFile]*

Screen:

```
                              M E R G E

+------- MATHS.DAT--------+                          +------- FINAV.DAT--------+
|Survey No.:  99          |                          |Survey No.:  99          |
|No. Records:   8103      |                          |No. Records:   8103      |
|Record Length: 12        |                          |Record Length: 10        |
|Sample Interval: 10      |                          |Sample Interval: 10      |
|Range:  39 125510        |                          |Range:  39 125510        |
|        40 112530        |                          |        40 112530        |
+-------------------+-----------MERGE Options------------+-------------------+
                    | Output file: MERGE.DAT          .  |
                    | Start time:   0 000000             |
                    | Stop  time:   0 000000             |
                    |   10  -->   9                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
                    |    0  -->   0                      |
+-------------------|    0  -->   0                      |-------------------+
|                   +------------------------------------+                   |
+----------------------------------------------------------------------------+
```

How MERGE works:

The program reads two files and merges designated channels of data from one file to the other. The first file asked for by the program is the one to merge data into and the second is the one from which data is copied into the first. The input files are unchanged and the output is written to a new file.

Notes:

- The two files must have the same sample interval.
- The two files may have different record lengths and different time spans, that is, they do not need to start or finish at the same time as each other.
- When merging channels from one file to another, use the file containing the most amount of channels (that you want to retain) as the file to merge into.

MLIST

Purpose: MLIST lists the values of specified channels (at a specified sub-sample interval) of a data file and report any time jumps occurring in the file.

Command: MLIST *[AnswerFile]*

Screen:

```
                                  M L I S T

                                        +-Channels-++-------- TEST.DAT--------+
                                        | 3 f12.2  ||Survey No.: 104          |
                                        | 4 f12.2  ||No. Records:    5064     |
                                        | 0 *****  ||Record Length: 10        |
                                        | 0 *****  ||Sample Interval: 10      |
                                        | 0 *****  ||Range: 268 161800        |
                                        | 0 *****  ||       269 062220        |
 +------- Listing Details-------+       | 0 *****  |+-------------------------+
 | Start time:    0     0       |       | 0 *****  |
 | Stop  time:    0 000000      |       | 0 *****  |
 | Start/Stop Record :    1  999|       | 0 *****  |
 | Subsample (secs)     :  60   |       | 0 *****  |
 | Sample interval of file: 10  |       | 0 *****  |
 | Check Time Order     :   Y   |       | 0 *****  |
 | List Dec, Hex or Gaps :  D   |       | 0 *****  |
 | Channel for latitude  :  3   |       | 0 *****  |
 | List output: TERM            |       | 0 *****  |
 +------------------------------+       | 0 *****  |
                                        | 0 *****  |
                                        | 0 *****  |
                                        +----------+

+---------------------------------Messages-----------------------------------+
|                                                                             |
+-----------------------------------------------------------------------------+
```

How MLIST works:

MLIST views the contents of a binary file containing survey number, day and time information in channels 1 and 2. It can display the data contained in specified channels at each sample time and can go directly to a point in the file according to time or record range. There is an option to report any time jumps in the file.

Notes:

- The sample interval shown in the right top window is the time difference between the 1st and the 2nd record of the file. The user is asked to enter the sample interval anyway just in case there happens to be a time jump between these 2 records causing this number to be wrong.

- A Start and Stop Time of zero indicates that the whole file (with the specified sub-sampling) is to be listed. If Start Record is non-zero, it over-rides the start time. If Stop Record is non-zero, it over-rides the stop time.

- To list data values in decimal, do time order checking, check valid survey numbers and output latitude and longitude in degrees and minutes, use the "Decimal" option.

- To provide a gap report, use the "Gaps" option. The first 4 channels given in the Channels window will be examined for gaps and the output can be sent to a file according to what is specified for List Output. To view the report on screen, set screen width to 132 characters before running MLIST.

- To list the file in hexadecimal, use the "Hex" option. This option will not perform any computations on the values in each field and may be used to inspect corrupt files. Only the first 5 channels given in the channels window are listed.

- The longitude and latitude channels in a data file normally have their values stored as radians. To list the longitude and latitude in degrees in 2 extra columns at the left of the listing, specify a channel that contains the latitude (in radians). It is assumed that the channel following this one contains the longitude. If these 2 extra columns are not required, enter a 0 for the latitude column.

- To send the listing to the screen (terminal), enter TERM for list output, otherwise enter a filename. If you want the listing sent to a printer, specify a filename for this option, then when the program is finished, send the file to the printer in the usual way and delete the file if it not needed. If you want a listing of only the time jumps, either specify a very large subsample interval or produce a listing file and then enter the command:

  search *ListFile* "#"
  or search/out=*ListFile2* *ListFile* "#"

  (This latter method lists only those lines containing the # character.)

- The formats for the specified channels can be either 'Fw.d' formats or 'Gw.d' formats where w is the width of the field and d is the number of decimal points. For 'Fw.d' formats w must be at least 1 greater than d and for 'Gw.d' w must be at least 7 greater than d.

PCEDAT

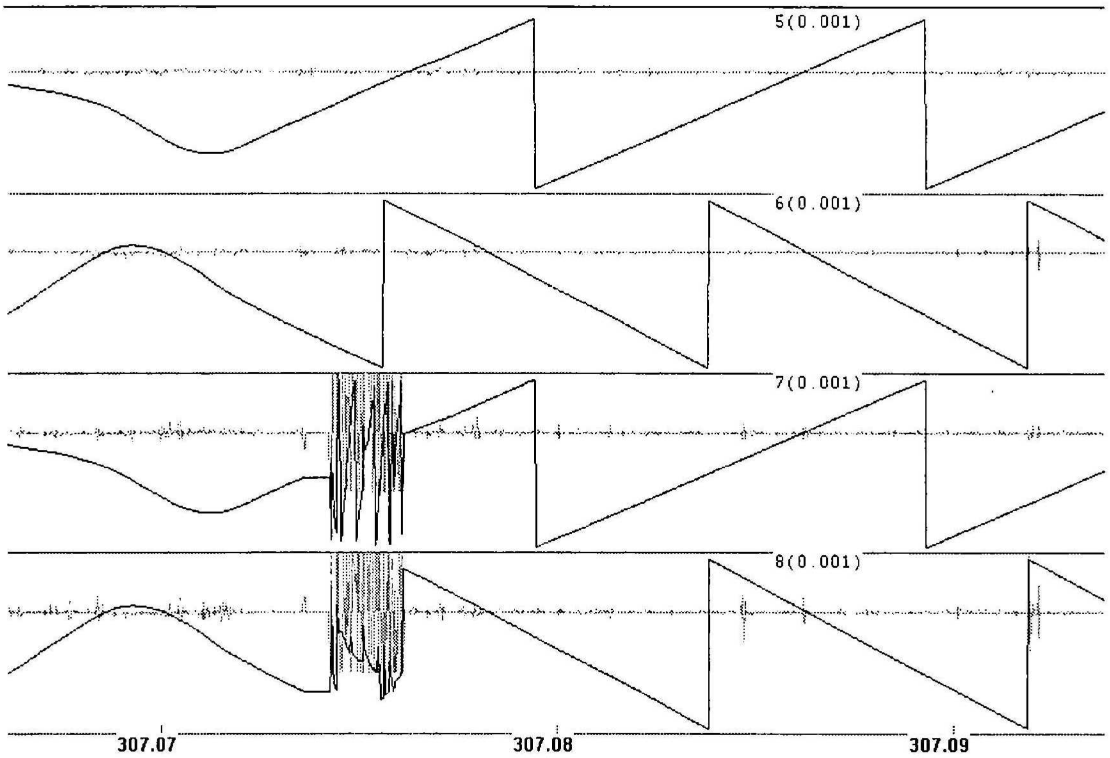
Purpose: View and edit data channels in a VMS binary data file.

PCEDAT is a C++ program used for the viewing and interactive editing of VAX/VMS binary data files. The files are usually accessed across the network using PathWorks, although, if the network is slow or unreliable, it better to copy the file onto the PC's hard disk using File-Manager or the DOS copy command and access it locally.

When copying binary data files back onto the VAX, it is necessary to use the DATCOPY batch procedure so that the correct VMS file type is created on the VAX. Simply enter DATCOPY at the DOS prompt and you will be instructed on the details that need to be entered (eg. the number of channels in the file).

Command: Double-click on the PCEDAT icon.

Screen:



Notes:

- Up to 6 data channels can be viewed and edited at a time. With each data trace is a green 4^{th} or 2^{nd} difference trace - this is a good indicator of abnormalities in the data. The scale of the data trace, scale of the difference trace, type of difference plot, relative width of each trace strip, zoom factor (when going from overview mode to edit mode) and number of data points displayed on the screen are set in the OPTIONS menu. The options settings can be saved to a file and reloaded at any time. Many different options settings can be saved and retrieved using this system.

- The Edit BUTTON at the bottom of the screen takes the program into edit-mode. The Edit MENU at the top of the screen is used to select the type of edit to be performed. The range to be edited (or unedited!) is selected by clicking on 2 points (while in edit mode). Note that a powerful feature of this program allows the user to select 2 data points on **different** traces. The same edit is then applied to both channels (and any channels displayed in between) simultaneously. Single points can also be edited.

- Data traces can be shifted up 1/2 a strip so as to get the data trace to 'step back' at a different location if details are currently obscured by a 'step back'.

- A part (or whole) of any display can be copied into the Windows clipboard using the Picture menu. The picture above was captured in this way and then copied and pasted into this document.

- As with any Windows program the easiest way to see how the program works is - try it out.

Saving of Edits:

Edits are saved when:- any of the buttons at the bottom of the screen are pressed, the program is exited, a new file is opened, options are changed or the Actions-GoTo menu is used.

Operations that can be performed without saving edits are:- re-sizing of the screen (or reducing the program to an icon), shifting the traces, copying to the clipboard, deleting or creating the data value display dialogue or taking a note.

The ONLY way to reverse the result of an edit is to use the Edit-Undo menu. To undo the edits on all channels in one go, select the first point on the top channel and the last point on the bottom channel and choose Edit-Undo.

Petroseis

Purpose: Petroseis is a basin analysis tool and is used by Non-Seismic Processing for mapping, gridding, profiling and mistie analysis functions applied to UKOOA and pseudo-UKOOA format files.

Command: PS747 for VaxStation or
pseis760c[4] for application on Unix system. Users should first see IT support staff to ensure they are set up correctly.

Notes:

For correct display of windows on the vaxStation, make sure you have the file DECW$XDEFAULTS.DAT in your login directory.

Refer to the Petroseis manuals for program instructions.

In order to improve performance of the Petroseis software, use the following command from the working directory that will compress the panels.pnd file in that particular directory. Use the command once for a directory or after using the reset option in the Petroseis menu.

$ @ps_exepath:ps_run utpcopy -c panels.pnd.

Users can also use the command "cmp$panels" that will have the same effect.

To rotate a plot for plotting on the HP Design Jet printer, do the following:
Import the data; view the .CGM file; using the VIEW drop-down box, rotate the image 3 times in succession (this will rotate through 270 degrees); save to a .pic file format; plot the .pic file to the HP Design Jet printer.

[4] Correct at the time of writing.

PLTCH

Purpose: Plot the traces of channels on a zeta plotter.

Command: PLTCH *[AnswerFile]*

Screen:

```
                                P L T C H

+------ PLTCH Main Options ----+                   +-------- SMTH.DAT--------+
| Plot File : PLTCH.PLT        |                   |Survey No.: 106          |
| Line File : SEISLIN.ASC      |                   |No. Records:   8609      |
| Start : 330 110000           |                   |Record Length:  8        |
| Stop  : 331 123400           |                   |Sample Interval: 60      |
| X-scale (cm/hour): 2.0       |                   |Range: 332 110920        |
| Pen offset (cm) : 1.4        |                   |       333 110400        |
+------------------------------+                   +-------------------------+
                 +-Chans-Type---Range of Values-----Plot range-Pen-Blks-+
                 | 3  0  2 -0.1963E-03  0.1963E-03  0.0 25.0   1   1 |
                 | 4  0  2 -0.1500E-03  0.2427E-03  0.0 25.0   1   1 |
                 | 5  0  1  -2500.      0.0000E+00  0.0 25.0   1   1 |
                 | 6  0  1  0.0000E+00   5000.      0.0 25.0   2   1 |
                 | 7  0  1  0.0000E+00   500.       0.0 25.0   3   1 |
                 | 7  0  2  -75.00       175.0      0.0 25.0   3   1 |
                 | 6  0  2  -500.0       2000.      0.0 25.0   2   1 |
                 | 0  0  0  0.0000E+00  0.0000E+00  0.0  0.0   0   0 |
                 | 0  0  0  0.0000E+00  0.0000E+00  0.0  0.0   0   0 |
                 | 0  0  0  0.0000E+00  0.0000E+00  0.0  0.0   0   0 |
                 | 0  0  0  0.0000E+00  0.0000E+00  0.0  0.0   0   0 |
+----------------| 0  0  0  0.0000E+00  0.0000E+00  0.0  0.0   0   0 |-----+
|                +---------------------------------------------------+     |
+--------------------------------------------------------------------------+
```

Notes:

- The above example gives the values which should be used for plots of the 1-minute final data files.
- A start and stop time of zero indicates that the whole file is to be plotted.
- Two channels are prompted for. If the second channel is zero, the first channel is plotted. If 2 valid channels are specified, the difference between the 2 channels is plotted.
- The type of plot is whether to plot the channel values (type=1) or the difference between succeeding values (type=2).
- Each trace is plotted within a defined strip on the plotter paper. Of the two values specifying the 'range of values', the first is the value at the base of the strip and the second is the value at the top of the strip. Values outside this range will be accommodated for by the trace 'stepping back'. The 'plot range' is the height of the bottom and the top of the strip (in cm) on the plot paper. The paper is about 28 cm wide.

- The last two parameters describing the traces are the pen colour and the way that blank values are represented.

- The line file option allows for annotation of the seismic start/stop times across the top of the plot. The program reads a file in the same format as *SEISLIN.ASC* (See Appendix 2). For no annotation, enter NONE.

- The pen offset allows for the time axis to be aligned with the graph paper grid.

- To send plot to the Zeta: $ copy *plot_filename* zeta, or in the above example,
  $ copy pltch.plt zeta

PSMAP

Purpose: Produce a map of the ship's track, with symbols plotted at a specified frequency. The track can be labelled with up to 3 channel values at 3 independent frequencies. Often the time channels (1 & 2) are used as labels. Time intervals over which to draw the track can be selected and many data files can be used to supply the navigation data. Coastlines can be included on the map. Additionally, data value profiles can be plotted along (preferably straight) track lines.

Viewing Maps: PSMAP creates an output plot file in an ASCII format and this file can be viewed using Petroseis. The output plot file name (without an extension) should be specified in the introductory screen of PSMAP and the program will append the extension .CGM

The *.CGM file can be sent to the plotter as is. To avoid the "edge problem" for large maps, save the VIEW as a *.pic file, exit from VIEW, then use PLOT to send the *.pic file to the plotter.

A higher quality result can be achieved by sending the plot to the postscript plotter which lives in the Image Processing Section. First use CONVERT to create a postscript file (*.ps) from the *.pic file, then,

from Unix:

% lpr -Pclastic *filename.ps*	to send file
% lpq -Pclastic	to check queue

from VMS:

$ print/que=clastic_que/notify *filename.ps*

Command: PSMAP *[Answer_file]*

Help System:

For each of the menu options more guidance is given when the prompt appears. Simply move the cursor over an option and press the RETURN key for more information on an option.

Map-Base Details:

```
                              P S M A P

+--------------------------- Map Base Details----------------------------+
| Big title: PHILIPPINES PROJECT                                        . |
| Small title: PHILIPPINES                                                |
| Bottom title: TEST MAP                                                  |
| Map number:   1                                                         |
| Map top (deg,min)       : -12  0                                        |
| Map bottom (deg,min)    : -14 30                                        |
| Map west edge (deg,min): 120 50                                         |
| Map east edge (deg,min): 123 30                                         |
| Map base type: Crosses                                                  |
| Scale - 1:     500000.                                                  |
| Grid - lat: 120  30 long: 120  30                                       |
| Notes file: TKNOTE.TXT                                                  |
+-------------------------------------------------------------------------+
    | Base value for pr|                                              |
    | Range per inch fo|                                              |
    | Pens for profiles+----------------------------------------------+
    | Time ranges file:PHIL.TIM                               . |
    +-----------------------------------------------------------+
+------------------------------------Messages------------------------------------+
|                                                                                |
+--------------------------------------------------------------------------------+
```

Notes File:

The notes file contains notes to be written at the bottom of the map to the left and right of the linear scale bar. The format of the notes file is as follows:

```
*NOTE1
These are the notes for the LEFT of the linear scale bar at the bottom of
the map.
The lines can be up to 80 characters long and there can be up to about 20
lines for this set of notes.
      .
      .
      .
*NOTE2
These are the notes for the RIGHT of the linear scale bar at the bottom of
the map.
The lines can be up to 80 characters long and there can be up to about 20
lines for this set of notes.
      .
      .
      .
```

Projection Details:

```
                                P S M A P

+--------------------------- Map Base Details----------------------------+
| Big title: PHILIPPINES PROJECT                                        . |
| Small title: PHILIPPINES                                                |
| Bottom title: TEST MAP - DAVID COLLINS                                  |
| Map number:   1                                                         |
| Map top (deg,min):  14  0                                               |
| Map bottom (deg,min):  12 30                                            |
| Map west edge (deg,min): 120 50                                         |
| Map east edge (deg,min): 123 30                                         |
| Map base type: Crosses                                                  |
| Scale - 1:     500000.+-------------- Projection Details--------------+ |
| Grid - lat:  30 long:| Projection: Simple Conic                      | |
| Notes file: CHRIS.NOT| Parallels - top(deg,min): 14  0 bottom: 12 30 | |
+----------------------| Datum    : WGS84                              |---+
    | Base value for pr+-----------------------------------------------+
    | Range per cm for profiles  :      50                       |
    | Pens for profiles          : BLACK    GREEN                |
    | Time ranges file: PHIL.TIM                               . |
    | Survey Defn file: NONE                                   . |
    +----------------------------------------------------------+
+----------------------------------Messages----------------------------------+
|                                                                            |
+----------------------------------------------------------------------------+
```

Track-Map Details:

```
                                P S M A P

+--------------------------- Map Base Details----------------------------+
| Big title: PHILIPPINES PROJECT                                        . |
| Small title: PHILIPPINES                                                |
| Bottom title: TEST MAP - DAVID COLLINS                                  |
| Ma+---------------------- Time-Based Data---------------------+         |
| Ma| Navigation channels:  3    4                              |         |
| Ma| Symbol number:   1                                        |         |
| Ma| Symbol frequency(sec):   -3600                            |         |
| Ma| Label freq (sec):   10800 10800 10800                     |         |
| Ma| Channels for labels:    1    7    2                       |         |
|   | Line break gap (sec):    60                               |         |
| Gr| Label height (mm) : 1.50                                  |-----+   |
| No| Symbol height (mm) : 1.00                                 |     |   |
+---| Point plot frequency:       60                            |2 30 |---+
    | Channel to profile:  7                                    |     |
    | Draw baseline (Y/N): Y                                    |     |
    | Base value for profiles: 0.                               |     |
    | Maximum value for profiles: -2050.                        |     |
    | Range per cm for profiles:   100.                         |     |
    | Pens for profiles: BLACK    GREEN                         |-----+
    | Time ranges file: PHIL.TIM                              . |
    | Survey Defn file: SURVDEF.ASC                           . |
    +----------------------------------------------------------+
+----------------------------------Messages----------------------------------+
|  Datum : WGS84 a=6378137, f=1/298.25722                                    |
+----------------------------------------------------------------------------+
```

Profiles:

An effective way to plot profiles is to choose an approximate mean value as the base value and to choose a different pen colour for the values above the base value to those below the base value. The 'pens for profiles' option allows this pen selection.

Time Ranges File:

The time ranges file is used to specify the data file(s) containing the navigation data, changes in pen colour and style, changes to which channels contain navigation data, time intervals or record intervals to plot and coastline files to use. Directives in this file are acted on in the same sequence as they are written. All words and numbers are separated by any number of spaces, except for the time specification line (see below). These time ranges files should be given the suffix *.TIM.

The directives are as follows:

TEXT *n* - change text colour to n where {n:n=1,2,3,4,5,6,7,8}

n	1	2	3	4	5	6	7	8
Colour	black	green	yellow	dk. blue	purple	lt. blue	red	orange

LINE *n* - change line colour to n where {n:n=1,2,3,4,5,6,7,8}. Codes as in the above table.

STYLE *n* where {n:n=1, 2, 3, 5, 6, 7, 102 - 125}. See *Petroseis 6.01 User's Guide Appendix I-2* for graphic display of these styles.

n	**Linestyle**	*n*	**Linestyle**
1	continuous	111	continuous, Δ pointing away from line
2	short dash	112	continuous, ∇ pointing towards line
3	dot	113	continuous, □ on line
5	dash	114	continuous, O bisected by line
6	dash, dot, dot	115	continuous, I bisected by line
7	dash, dot	116	continuous, alternating ⊥ on line
102	dash, space	117	continuous, + bisected by line
103	long dash	118	continuous, II bisected by line
104	long dash, dot	119	continuous, ↓ pointing towards line
105	long dash, dash	120	long dash, ABCDE
106	long dash, dash, dash	121	Δ, long space
107	long space, dash	122	∇, long space
108	extra long dash	123	□, long space
109	continuous, ↑ pointing away from line	124	continuous, double headed arrow
110	extra long dash, X	125	continuous railway track

SYMBOL *n* - set symbol to n where {n: n=0,1,2}

n	0	1	2
Symbol	square	octagon	triangle

FILE *file_name* - open the specified file for reading - if a TIME or RECORD directive does not follow this directive before the end-of-file, a COAST directive or another FILE directive, all of the ship's track is plotted.

The FILE directive recognises only VMS binary and ASCII UKOOA files and distinguishes between them by looking at the extension. The binary file names must have *.DAT extension while the ASCII file names must have *.ASC, *.UKO, *.STR or *.REC extension. Any number of files can be plotted, including combinations of time-based and shot-based files.

NAV *y x* - the latitude and longitude is stored in the 2 channels (y,x) specified.

TIME *survey day.hhmmss day.hhmmss* - plot the track map for the specified time interval. The format of this record must be:

'TIME', X, I3, 2(X, F10.6)

RECORD *rec1 rec2 symfreq labelfreq1 labelfreq2 labelfreq3* - plot the track for the interval between records rec1 and rec2. Plot a symbol every symfreq records and plot the 3 labels (chosen in the menu system) at the 3 frequencies specified. This option is used for those binary files which have line number and shot number in the time fields.

COAST *file* - This command is used to plot any continuous line on the map from the file specified. This was originally designed to plot the coastline files, however it can also be used to plot water depth contours, the 200 mile nautical boundary and others. These files have the same format as the coastline files. At the time of writing the files available were: GEBCO depth contours, 200nm boundary, Aust Economic Exclusive Zone, Legal Continental Shelf and the ZOCA boundaries. They are contained in the nsp$disk:[nsp1.misc] directory.

NOTE: PSMAP will read either of the two unformatted files AUSCOAST.DAT and HPCOAST.DAT. The latter was the file used on the HP and covers an area of approximately 8° 15' N to 47° 20' S and 96° 55' to 183° 40' E. The former contains only the Australian coastline, but has better resolution, having been digitised from 1:250000 map sheets.

When plotting ASCII shot-based data, the UKOOA directive must be used and must precede the FILE directive. Other directives listed below are optional.

UKOOA *n m f* - all subsequent UKOOA files will have symbols plotted every n shotpoints and labelled every m shotpoints. If n <= 0, a line will be drawn between the shotpoint symbols. f is the line label plotflag (1 to plot, 0 to omit).

ADDLINES - Lists the lines to be plotted in a given file (if not included, all lines in the file are plotted by default). This directive must precede the file command (for the file it is to operate on) and be followed by the exact line string to be plotted preceded by a '*', e.g.
ADDLINES
*95MK-127
*95MK-124
*. . . . .

DOUBLE - Doubles the line strength of each of the lines specified. This directive is invoked in identical fashion to ADDLINES above, i.e. it must precede the file command (for the file it is to operate on) and be followed by the exact line strings of the selected lines. To double all lines within a survey, use the shorthand command, DOUBLE ALL.

MULTI - Automatically plots each seismic line contained in each file with a different coloured pen.

SHOTFREQ *x* - This directive is optional and specifies the shotpoint frequency with which to plot seismic lines. It may be used to reduce the size of large CGM output files and can be called any number of times after the UKOOA directive. The value of x should integer divide the values of n and m in the UKOOA directive described above.

MAXBREAK *n* - This directive is optional and will break the plotting of a seismic line (as well as annotating linenames) when the difference between consecutive shotpoint numbers exceeds the value, n. It is mainly for use with foreign shotpoint data where there can be large jumps in shotpoint numbers (and corresponding positions) within seismic lines.

A minimum time ranges file consists of just one FILE directive. An example of a time ranges file follows:

```
! comment line starts with a '!'

SYMBOL 0
TEXT 8
LINE 1
FILE NSP$DISK:[NSP3.TI]S110FD.DAT
TIME 109.268.170000.268.204500
TIME 109.268.213500.268.220500
TIME 109.268.223500.269.020500
     .
     .
UKOOA -100 1000 1
SHOTFREQ 5
TEXT 4
LINE 7
FILE NSP$DISK:[NSP3.UK]S119FD.UKO
     .
     .
LINE 6
COAST NSP$DISK:[NSP1.MISC]HPCOAST.dat
```

Other Notes

- See also program CTIM for the automatic creation of PSMAP control files.

- An option exists at the end of the program to save the PSMAP answer files to a unique name in the user's home directory. This is useful for client requests, where it may be necessary to save answer files for further use.

- When a negative number is specified for the "Channel to profile" option, the program will only plot the ship's track where data for that channel exists.

RESAM

Purpose: Resample a binary file from one sample interval to another.

Command: RESAM *input_file* *output_file*

Notes:

- If the command, RESAM, is entered without any parameters, VMS prompts for the 2 files in the following fashion:

  _File to subsample:
  _File to create:

- The output file is produced simply by sub sampling the input file - no averaging is done.

- The program is normally used to resample a file from 1-second to 10-second sample interval or from 10-second file to 60-second sample interval.

RESEQ

Purpose: RESEQ is used to resequence and merge a set of lineparts from a UKOOA file into one line with a continuous, incrementing set of shotpoint numbers.

Command: RESEQ *[Answer_file]*

Screen:

```
                              R E S E Q

+-------------------- RESEQ Instructions --------------------+
|Output file    : frend$dkb700:[nspl.s137]s003.reseq          |
|Output line label  : 137/000300                              |
|Start output ShotPt:    100                                  |
|-----------------------------------                          |
| Linepart         startSP endSP  Incr                        |
|137/000300          2535    166    -1                        |
|137/000300           155   4703     1                        |
|      0      0      0                                        |
|      0      0      0                                        |
|      0      0      0                                        |
|      0      0      0                                        |
|      0      0      0                                        |
|      0      0      0                                        |
|                                                            |
+------------------------------------------------------------+

+------------------------------ Messages ---------------------------------+
|                                                                         |
+-------------------------------------------------------------------------+
```

How RESEQ works:

RESEQ takes data from a UKOOA file and merges and resequences the lineparts according to the instructions given in the menu. All lineparts must exist in the UKOOA file in the order given in the instructions. The UKOOA data must have incrementing shotpoint numbers and data is output from a given start shotpoint and incremented continuously by 1.

To use RESEQ, a map should be made of the lineparts to be merged. The start shotpoint (from the map) and the end shotpoint should be entered for each linepart to be merged along with the shotpoint increment. (eg if the startSP = 1100 and the endSP = 100, the increment will be -1).

SALVG

Purpose: Allow digitised values to be used for correcting noisy data. Mainly used for water depth correction, but will work in principle for any channel.

Command: SALVG *[AnswerFile]*

Screen:

```
                              S A L V G

                                       +------- S106PD.DAT ------+
                                       |Survey No.:  106          |
                                       |No. Records:  42832       |
                                       |Record Length:   8        |
                                       |Sample Interval:  60      |
                                       |Range:  320 080000        |
                                       |        350 015100        |
                                       +-------------------------+

+----------- SALVG Options ------------+
|Output data file: S106SA.DAT          |
|Corrections file: S106EPC.ASC         |
|Input, Output channels :    5    8    |
|Write Log      : Y                    |
+--------------------------------------+

+---------------------------Messages---------------------------+
|                                                              |
+--------------------------------------------------------------+
```

How SALVG works:

The process applied by SALVG can be described as follows, using the example of water depth data:

The user accurately selects water depth values at specific times over an adjustment interval. These points are referred to as "tie points" and can be obtained from the analogue records. The user also defines a threshold of acceptance of the digitally recorded values.

Consider a set of points recorded digitally as (t_1, w_1), (t_2, w_2), (t_3, w_3) and (t_4, w_4). Say the user specifies tie points at (t_1 , y_1) and (t_4 , y_4) using the analogue records. SALVG replaces w_1 by y_1 and w_4 by y_4. Then it "draws" a straight line between the tie points. In examining the point at t_2, SALVG calculates the difference between the digital value at t_2 and the interpolated value at t_2 and compares this difference with a user specified threshold value, say δ.

If $|y_2 - w_2| < \delta$, then w_2 is accepted as good and the new tie points become (t_2, w_2) and (t_4, y_4).

If $|y2 - w2| > \delta$, then w_2 is replaced by y_2 and the new tie points become (t_2, y_2) and (t_4, y_4).

This process is repeated in examining every digital data value within a specified adjustment interval.

Notes:

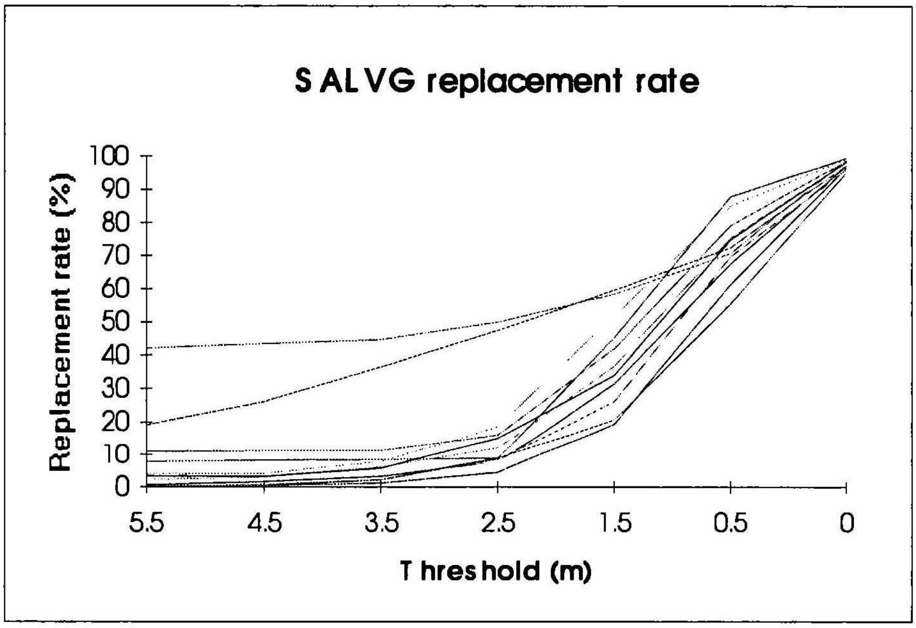
- Water depth values are to be negative numbers.
- No correction is made for transducer to water-line, a distance of 4-6 metres. This correction should be made at the completion of water depth processing using MATHS.
- SALVG won't work correctly if the intervals between digitised points are less than the sample interval of the data file. Use EPCTIME to correct the DIGIT output files before running SALVG.
- The program allows for adjustment and deletion of data intervals and these operations are controlled by the corrections file, S106EPC.ASC in the above example screen.
- An example of a corrections file follows:

```
*A                                              start adjustment interval ('*A')
TH  2.0                                         set threshold to 2 m ('TH', 2X, F5.1)
DE  48.0                                        set delay to 48 m ('DE', 2X, F5.1)
106.325.194000 -103.0                           (format F7.3, F7.6, X, F7.1)
106.325.195000 -105.0
106.325.200000 -107.0
/T                                              end of adjustment interval ('/T')
*A                                              start adjustment interval
106.326.044000 -105.0
106.326.044700 -108.0
/T
*D 106.326.050000 106.326.060000 delete data    ('*D', 2(X, F7.3, F7.6))
*D 106.326.073000 106.326.095300
TH  3.0                                         reset threshold
*A
106.326.120000 -110.0
106.326.120700 -113.0
/T
/E                                              end of corrections file ('/E')
```

- While it is allowed to change the delay and threshold within an adjustment interval, it is preferable to do so between adjustment intervals.
- The delay is the difference between the digital and analogue values. In the above example, the delay is 48m and therefore the actual tie value at 106.326.120700 is -65 m. The magnitude of the delay should be obtained from the analogue records or the systems report.

- The approach adopted for survey 106 water depth correction involved using SALVG with a 50% replacement rate and PCEDAT. While it is possible to use PCEDAT exclusively to correct water depth data and which results in a very smooth curve, this approach will lead to a rejection of almost all of the digital data and mask the noise character of the good data. Therefore, it is suggested that a combination of PCEDAT and SALVG be used. PCEDAT should only be used in those areas where the digital values are reliable. SALVG should then be used in the problematic areas. Finally, PCEDAT should be used to "tidy up" and validate the final data.

- The setting of the threshold should be carefully determined to yield the maximum replacement of bad values, while retaining as many good values as possible. Values will be considered "good" if the noise level of the final corrected water depth data is less than about +/- 3m. Below is a graph showing the replacement rate for 12 representative adjustment intervals from S106.



Each adjustment interval was more than 200 minutes long. The steepness of the curve is dependent on the level of noise in the particular interval.

SMTH

Purpose: Smooth noisy data using a SINC filter.

Command: SMTH *[AnswerFile]*

Screen:

```
                                  S M T H

                                                   +-------- MAG.DAT---------+
                                                   |Survey No.: 106          |
                                                   |No. Records:    8609     |
                                                   |Record Length:  4        |
                                                   |Sample Interval: 10      |
                                                   |Range: 332 110920        |
+-------------SMTH Options--------------+          |       333 110400        |
| Output data file: SMTH.DAT          . |          +-------------------------+
|    3  -->   4       3      180        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
|    0  -->   0       0        0        |
+---------------------------------------+

+-------------------------------Messages---------------------------------+
|                                                                        |
+------------------------------------------------------------------------+
```

How SMTH works:

SMTH smooths data in specified channels using a sinc filter. The user specifies the number of zero-crossings (see diagram below) and the period of the function in seconds. At each sample, the program computes the new, smoothed data value by a weighted average of the values within the period specified. Normalised weighting coefficients are provided according to a sinc function.

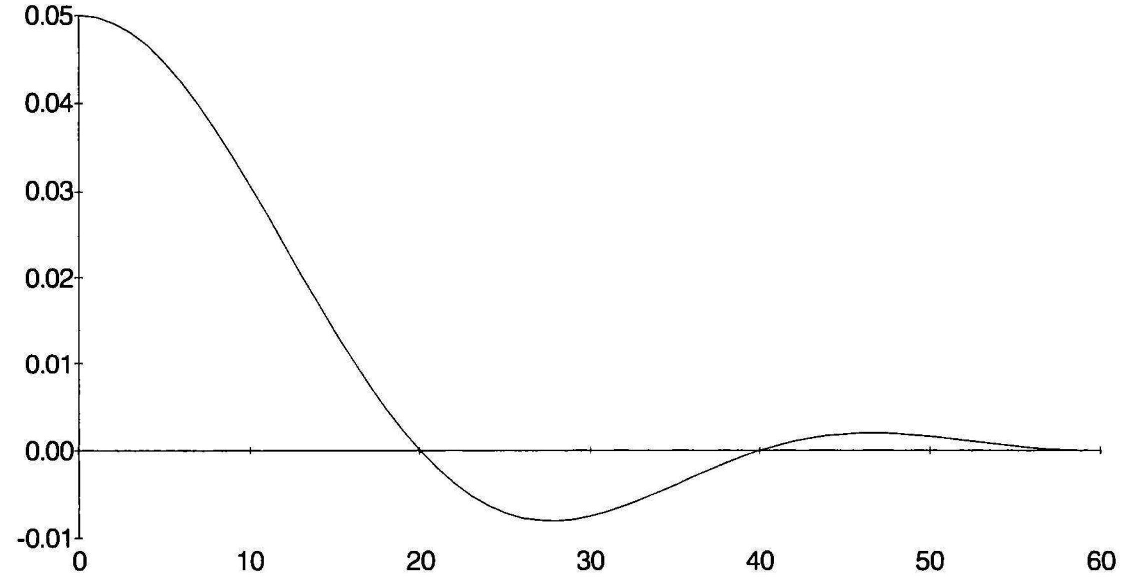
Notes:

- The SINC filter is based upon a sine function that decreases in amplitude as X is moved away (on either side) from the Y-axis, thus when this filter is applied to a data point, the points close to the data point are given more weighting than those further away. The 2 parameters that are specified for the filter are the cut-off (ie. how many times the SINC curve crosses the X-axis, on both sides of the Y-axis, before cutting the filter off) and the period of the SINC function.

- For reasonable quality 10 sec navigation data, it is recommended that 3 zero-crossings and period of 60 seconds be used. When applied to magnetic data these parameters will remove noise without effecting small anomalies such as wellheads.

- The following graph (which is produced with a spreadsheet using the formulas directly from the SMTH program code) shows the shape of the smoothing curve. This curve was generated using a cut-off of 3 zero-crossings and a period of 40 seconds.

Shape of the function (with three zero-crossings) used for smoothing. The diagram only shows half of the function, which is symmetrical about the Y-axis.



SPNUM

Purpose: To resequence and rename lines in a UKOOA file.

Command: SPNUM *[answer_file_name]*

Screen:

```
                              SPNUM

+----------------- SPNUM Specifications ---------------------+
| Output file           : S110NUM.UKO                        |
| Method                : S                                  |
| Parameter File : MENU                                      |
| Old -> New      110/01P2      2114     110/01       1196.  |
| Old -> New      110/12P2      6061     110/12       4894.  |
| Old -> New      110/02P1       153     110/02        153.  |
| Old -> New      110/02P2      2100     110/02       1743.  |
| Old -> New      110/05P1       158     110/05        158.  |
| Old -> New      110/05P2      1842     110/05       1493.  |
| Old -> New      110/01P1       181     110/01        181.  |
| Old -> New                                                 |
| Old -> New                                                 |
| Old -> New                                                 |
| Old -> New                                                 |
+------------------------------------------------------------+

+--------------------------Messages--------------------------+
|                                                            |
+------------------------------------------------------------+
```

Notes:

- SPNUM uses the MENU to specify corrections or a parameter file, whose format must be a12, I6, x, a12, I6 for *old_line*, *old_spn*, *new_line*, *new_spn* respectively.
- The input file must be in AGSO UKOOA format.
- Where the user has specified a new line name different from an old line name, the resequenced line will have the new line name throughout.
- If a line only needs to be renamed, specify *old_spn* = *new_spn*.
- The specifications can be given in any order.
- The method is S if you just want to add 1 to the previous shot number starting from the *new_spn* given, or D if you want to maintain a constant difference of *old_spn* - *new_spn*.

SPNX

Purpose: To extract FFID's and FFID-time from the binary data files and correct for known errors.

Command: SPNX *[answer_file_name]*

Screen:

```
                              S P N X


+------------------ SPNX Specifications ---------------------+
|   Start/Stop file (input)          :  S109LIN.ASC          |
|   Shot-times file (output)         :  S109ST.ASC           |
|   FFID channel                     :    24                 |
|   FFID time channel                :    25                 |
|   maximum shot interval (s)        :    15                 |
|   Max interpolation int (s)        :    60                 |
|   Log Frequency (rec)              :  1000                 |
+------------------------------------------------------------+

+---------------------------Messages----------------------------+
|                                                               |
+---------------------------------------------------------------+
```

Notes:

- The start/stop file defines the limits of the seismic lines.
- The seismic lines file must have the format A10, 2(I4, X, I3, F7.6 ,X) for line name, survey number, start time, survey number, stop time respectively.
- The format of the output file is A10, I6, A1, I3, F7.6 for line name, spn, interpolation flag (*), ddd, .hhmmss.
- The maximum shot interval should be approximately 1.5 times the mean shot interval.
- The maximum interpolation interval allows interpolation for missing FFID's in the data file. The missing values occur because there have been buffering problems between the VAX and HP computers on board and the program compensates for this. The compensation is not meant to fill in genuine gaps, so don't use too large an interval. Use MLIST to inspect the data before you decide on a suitable interpolation limit.

STATS

Purpose: Quickly produce a page of statistics on the channels of a data file *and report any time jumps in the file.*

Command: STATS *DataFile*
or STATS/OUT=*ListFile DataFile*

Example of Output:

```
                              *** FTAPE.DAT ***
Ch Valid Blank                 Min                       Max          Gaps  Sgap  Lgap
-- ----- -----                 ---                       ---          ----  ----  ----

 1 10445     0       99.0390014648             99.0400009155       0  9999     0
 2 10445     0        0.0000000000              0.2359499931       0  9999     0
 3 10257   188        0.1894174069              0.2128469944       4    12    90
 4 10257   188        0.4576959908              0.5291650891       4    12    90

 5 10278   167        0.1894174069              0.2124565989       1   167   167
 6 10278   167        0.4576959908              0.5280066133       1   167   167
 7  5956  4489        0.0000000000           9694.9589843750      33     1  3977
 8   646  9799       89.6999969482           6666.5000000000      13     1  4099

 9     0 10445 1000000000.0000000000-1000000000.0000000000       0  9999     0
10 10445     0    -2096.3598632813          -1983.8295898438       0  9999     0
```

Notes:

- The information given for each channel in the file is - the number of valid values and the number of blank values in the file, the minimum and maximum value found, the number of data gaps and the size of the smallest and largest gap (as the number of records in the gap).
- For minimum value the program ignores zeros and counts them separately.
- Use screen width of 132 characters to view the output effectively.

STFIL

Object: To fill gaps in the spn sequence in the shot times file.

Command : STFIL *[Answer_file_name]*

Screen:

```
                              S T F I L

+--------------------- STFIL Options -------------------------+
| Shot-times file (output) : S110ST.ASC                        |
| Shot-times file format   : U                                 |
| Maximum spn gap to fill  :   20                              |
| Write to log file        : Y                                 |
+--------------------------------------------------------------+



+---------------------------- Messages -----------------------------
  +
|
  |
+-------------------------------------------------------------------
  +
```

Notes:

- The user may find that the shot times file and hence the UKOOA file, has missing records. The gaps may be filled by specifying an upper limit to the gaps to be filled. For example, if an upper limit of 1 is given, then only single missing spns and corresponding times are interpolated.
- The input file can be in any of 3 formats commonly used for shot-times files. These are 'UKOOA', 'ASCTAPE' and 'DAS'. See Appendix 2 for a definition of these formats.
- The output file will be in 'DAS' format.
- The log file will be a report of every interpolation made and any negative spn jumps.

SWAP

Purpose: Swap data from one channel to another.

Command: SWAP *[AnswerFile]*

Screen:

```
                                   S W A P

 +------- I/O channels ----------+              +------- FIXTM.DAT--------+
 | Number of output channels: 10 |              |Survey No.: 104          |
 | Old -> New : 0 5              |              |No. Records:    5067     |
 | Old -> New : 8 6              |              |Record Length: 10        |
 | Old -> New : 7 9              |              |Sample Interval: 10      |
 | Old -> New : 0 0              |              |Range: 268 161800        |
 | Old -> New : 0 0              |              |       269 062220        |
 +-------------------------------+              +-------------------------+

                                +------------Swap Specifications----------+
                                | Output data file: swap.dat            . |
                                | Swap specs. file: swap.swp              |
                                | Start time:     0 000000                |
                                | Stop time :     0 000000                |
                                | Do All : Y                              |
                                +-----------------------------------------+

+--------------------------------Messages-----------------------------------+
|                                                                            |
+----------------------------------------------------------------------------+
```

How SWAP works:

The program copies specified channels from an input file into specified output channels in a new output file. It can also and simultaneously create an output file with a new number of channels. The program will not work if any specified output channel number is larger than the number of output channels.

Special Notes:

- The time interval specified is the interval over which swapping takes place. Note that data outside the interval is not swapped but **is** copied to the output file.

Swap Specs File:

This should be named with the extension, .SWP. An example follows:

```
! SWAP.SWP - swap specifications file.

! output 6 channels
OUTPUT 6
3 3
4 4
0 5
8 6
```

Notes:

- Comment lines (starting with !) and blank lines are allowed anywhere in the file.
- The first non-comment line must be OUTPUT n, where n is the number of channels to be produced in the output file. This can be greater than the number of channels being swapped.
- If you want to fill a channel with 10^{10} then specify zero as the input channel. In the example above, channel 5 would be filled with 10^{10}.

UKCHECK

Purpose: To check a UKOOA file for shotpoint continuity and to report line statistics and inter-shot times and distances which fall outside user-specified thresholds.

Command: UKCHECK *[answer_file_name]*

Screen:

```
                              U K C H E C K


+---------- UKCHECK Specifications -----------+
| Output File       : S136FD.LOG              |
| Shot freq of input:    10                   |
| Minimum threshold distance(m):    15        |
| Maximum threshold distance(m):    25        |
| Minimum threshold time (secs):     6        |
| Maximum threshold time (secs):    12        |
| Write abbreviated output (Y/N): Y           |
+---------------------------------------------+


+-------------------------- Messages ------------------------------
+
|
|
+-----------------------------------------------------------------
+
```

Notes:

- The program expects to be given the shot sample frequency of the input UKOOA file.
- The checking procedure reports the start/stop shotpoints for each line, out of sequence shotpoints and all shots which fall outside the time/distance threshold limits. (Type "0" against the two time options to ignore the time threshold conditions.)
- Time ranges which run backwards are flagged.
- Changes in bearing of more than 30 degrees between consecutive shotpoints are flagged.
- Statistics are computed for each line and for the total survey. These statistics are: the total rhumb line distance, the total along-line distance, the mean shot distance, the standard deviation shot distance (line only) and the mean shot time.
- Mean times and distances are calculated by first omitting all Δt and Δx values which exceed 100 [secs|meters]/shotpoint.
- An abbreviated output of the line statistics can be produced for inclusion in reports.

UKOINFO

Purpose: Produce a seismic line control file for all lines contained in the shot-based database according to generic survey classifications.

Command: UKOINFO *[AnswerFile]*

Screen:

```
                              U K O I N F O

+-----------------UKOINFO Options-----------------+
| Output File              : SURVUKO.ASC           |
| Include CMS data         : Y                     |
| Include CMP data         : Y                     |
| Include AOTMP data       : Y                     |
| Include OTHER data       : Y                     |
| Include CONTRACT data    : Y                     |
| Include FOREIGN data     : N                     |
| Include TRIPARTITE data: N                       |
| Include NGDC data        : N                     |
| Include reprocessed surveys    : R               |
| Exclude :   0  0  0  0  0  0  0  0  0  0  0  0   |
| Exclude :   0  0  0  0  0  0  0  0  0  0  0  0   |
+--------------------------------------------------+


+--------------------------- Messages ----------------------------
+
|
|
+-----------------------------------------------------------------
+
```

How UKOINFO works:

The program reads a UKOOA control file (eg. *UKOOA.ASC*) and searches through every database file according to survey classification criteria (See GDAT). It then outputs basic information pertaining to each seismic line found.

Notes:

- The program reads the shot-based (UKOOA) control file, normally *UKOOA.ASC*.
- The program outputs information for each seismic line in the surveys which are selected according to generic survey classification. The information that is output for each seismic line are the filename, linename, SP number range, lat/long range, total line kms and the average inter-shot distance.
- The output from UKOINFO was designed to be used as input into program XSEIS.

UKOSAM

Purpose: To resample a UKOOA file created by UKOut.

Command: UKOSAM *[answer_file_name]*

Screen:

```
                              U K O S A M

+----------- UKOSAM Specifications -----------+
| Output File           : S040FD.UKO          |
| Sample Frequency      :   10                |
| Output Bathymetry     : Y                   |
| Survey Number         : S040                |
| Output Gravity        : TOTAL               |
| Output magnetics      : NONE                |
| Write Log             : Y                   |
+---------------------------------------------+


+---------------------------- Messages -----------------------------
+
|
|
+-------------------------------------------------------------------
+
```

How UKOSAM works:

UKOSAM reads a UKOOA file and resamples it to every nth shotpoint where n is the (shot) sample frequency specified in the menu. It also allows the user to present the gravity and magnetic data either as full-field data or anomaly data. The output format allows only one form of each type of data, but not both. After creating a file which contains potential-field anomaly data, the header should be manually edited to reflect this.

Notes:

- The UKOOA file produced by UKOUT will generally contain a record for every SPN and will be too dense for practical use. PETROSEIS won't function correctly if too many points are read into a line. Therefore, the UKOOA file will need to be resampled.

- Choose a sample interval which gives about 500 m spacing. For 20s shot interval this will be every 10^{th} shot.

- See the filename conventions for naming of the full and resampled files.

- A combination of geophysical data type can be specified for output. In the menu above, for example, water depths and total gravity values would be output, whilst there would be no magnetics (the columns assigned to magnetics would be filled with 9's).

UKOUT

Purpose: Given a file with shotpoint numbers and a time for each and a data file with navigation data covering the time span of the shotpoint file, produce a UKOOA format file with shotpoints and their locations along with other data.

Command: UKOUT *[AnswerFile]*

Screen:

```
                                  U K O U T

                                              +------- UKOUT.DAT -------+
                                              |Survey No.: 106          |
                                              |No. Records:  46200      |
                                              |Record Length:  8        |
                                              |Sample Interval: 60      |
                                              |Range: 317 230000        |
                                              |       350 005900        |
                                              +-------------------------+

+-----------------UKOUT Options--------------------+
| Shot-times file (input) : S136FD.ASC             |
| UKOOA file (output)     : S136FD2.ASC            |
| Bathymetry Channel      :  0                     |
| Gravity Channel         :  0                     |
| Magnetics channel       :  0                     |
| Latitude channel(s)     :  3 0 0 0 0 0 0 0 0 0 0 |
| Shot-times file format  :  U                     |
| Precision (output)      :  H                     |
| Write to log file       :  Y                     |
+--------------------------------------------------+

+------------------------------Messages------------------------------
+
|
|
+--------------------------------------------------------------------
+
```

How UKOUT works:

UKOUT reads a time for each shot from a shot-times file and picks off the navigation, gravity, magnetics and water depth data (if they exist) at the corresponding time from a time-based binary file. The output is in standard AGSO modified UKOOA format.

Notes:

- The opening screen requires the name of the binary unformatted file containing the navigation data.
- The bathymetry, gravity and magnetics data can be written to the UKOOA file. To NOT write this data enter a zero for the channel.
- An option exists to use a UKOOA file as a shot-times file.
- An example of the beginning of a shot file follows:

```
SURVEY 106

        106/01p1   168 324.155834
        106/01p1   169 324.155849
        106/01p1   170 324.155903
        106/01p1   171 324.155918
        106/01p1   172 324.155932
```

See Appendix 2 for DAS and ASCTAPE format.

- An example of the beginning of a UKOOA format file follows:

106/01p1	168	102533.1S1374535.1E	0	0324155834	0
106/01p1	169	102532.7S1374533.9E	0	0324155849	0
106/01p1	170	102532.3S1374532.8E	0	0324155903	0
106/01p1	171	102531.8S1374531.7E	0	0324155918	0
106/01p1	172	102531.4S1374530.7E	0	0324155932	0

See Appendix 2 for UKOOA format definition.

XSEIS

Purpose: To extract seismic data from the shot-based database in a given geographical area.

Command: XSEIS *[answer_file_name]*

Screen:

```
                              X S E I S

+--------------------XSEIS Options-------------------+
|  Seismic line file     : SURVUKO.ASC               |
|  Extraction type       : P                         |
|  Polygon file          : MENU                      |
|  Write headers?        : Y                         |
|  Bounding Rectangle    : -18 25 -23 50 113 00 118 30 |
|  Shot frequency        :    1                      |
|  Include wdepths?      : N                         |
|  Include gravity?      : Y                         |
|  Include magnetics?    : N                         |
|  Write Log             : Y                         |
+----------------------------------------------------+

+---------------------------- Messages -------------------------------
+
|
|
+---------------------------------------------------------------------
+
```

How XSEIS works:

The program first reads a seismic line control file which contains bulk information pertaining to each individual seismic line. Part of the information contained is the name of the data file (in the UKOOA database) which contains the seismic line and the bounding rectangle of the line. The program determines whether the bounding rectangle overlaps the search area (as given in the menu) and if so, searches the file for all shotpoints that lie within the search area. An option exists within the menu to either extract (to an output file) all the line data if any of the line crosses the area; only that part which crosses the area; or only those lines that lie completely within the area. The output file may consist of UKOOA records from a number of surveys, *with their original survey formats*. If the headers option is chosen, the survey data will be separated in the output file by embedded headers.

Notes:

- The input file should be a seismic line control file of the format type created by program UKOINFO.
- The search area may consist of either a geographic rectangle or a polygon. When using a polygon, a file containing the location of each vertex of the polygon in decimal degrees, format

2(x,f11.7) with each vertex on a separate line, should be entered at the "Polygon file" option. Use the directive *INSIDE or *OUTSIDE (See GDAT) on the first line of this file to specify whether the search should extract the seismic line records inside or outside the polygon respectively. Ensure, when using a polygon, that a search rectangle is specified which completely covers the polygon area.

- The output file consists of all relevant UKOOA format records as selected by the search. Options exist to extract (A)ll the data for a seismic line if any of it crosses the search area; that (P)art of each seismic line that lies within the area; and the line only if the (W)hole of the line lies within the area.

- Header information are embedded within the output file and are delimited by '#' marks in column 1.

- Options exist to include the geophysical data and to resample the SP numbers to the output file.

11. Miscellaneous Programs

AGD84

Conversion of position between WGS84 and AGD84 datum. Supersedes the program AUS84.

AGDUKO

Based on AGD84, this program takes a UKOOA file whose coordinates are on the WGS84 datum and converts coordinates to the AGD84 datum. Use DUKO to check the difference between the files, which should be about 200m.

ANT2SRC

Substitutes the latitude/longitude string from one UKOOA file and merges into another UKOOA file. (Originally used to substitute antenna position to source position in a streamer UKOOA file).

ARCOUT

Outputs an ASCII format compatible with ARC/INFO. Reads a UKOOA file and outputs a number of files (one for each line - generic filename SSS_lineno.ARC) containing data of the form:

shotnumber
declat, declon
shotnumber
declat, declon
......
......

The program assumes the UKOOA file is of generic file name SnnnXX.ASC, where nnn is a three-digit integer and XX is a data identifier character string and that the linenames in the file are normal AGSO format sss/XXX... , where s is a three-digit integer survey number and XXX... is a linename character string.

ASCII_READ, ASCII_WRITE

This pair of programs read from and write to (at 80 bytes per record and blocked at 80 bytes) a 3480 tape cartridge in ASCII format. This has been written for use on the ship only.

ATSEC

Brother to ATMIN. The program needs the following input:

- input file name (binary file with time in channels 1 & 2 and one data channel)
- output file name (binary file)
- maximum interpolation interval (s) - won't interpolate if there are time jumps larger than this
timing mark to which to interpolate (10 or 60 sec)
- channel number of data to be interpolated

ATSEC2

Similar to ATSEC. The program needs the following input:

- input file name (binary file with irregular time intervals)
- output file name (binary file which is to have regular time intervals)
- timing mark to which to interpolate (10 or 60 sec)

BADLL

BADLL finds all bad latitude and longitudes from the navigation channels specified and replaces them with unknown values.

BLEND

BLEND computes the mean of 2 channels measuring the same parameter (eg water depth) which are on the same datum and scale. Supply the following parameters:

input file name
output file name
first channel
second channel
output channel
threshold

If one of the channels has a value exceeding 10^9, the output will be from the other one. If the difference between the channels exceeds the threshold, the output will be from the first input channel.

BLOUT

Blocks an ASCII file for output to tape

CDP2SPN

Initially written to resequence CDPs to SPs in a UKOOA file. This program should be edited in accordance with the resequencing requirements each time it is used.

CHECKST

Checks a shot-times file in DAS format for continuity. (PC and VAX)

CHUKW

Checks a UKOOA file for continuity and computes line shot interval.

CHUNK

Take a chunk out of a file. Provide start and stop record numbers.

CTIM

Create a control file for PSMAP for time-based data. Works similar to GDAT and STIM.

DATM77

Reads a binary file with standard database channel allocations and creates an MGD77 format output file. The program requires input of specific information about acquisition parameters for writing to the MGD77 headers. Some of the information is assumed as fixed and the same for most surveys, such as the type of gravity meter used. Check the headers in the output file to ensure that the correct information has been supplied.

DDAT

Computes the distance between points, at the same time, in two binary files.

DELBAD

Sets bad values to 10^{10} in the channel range specified.

DELZ

Deletes zeros (ie sets zero values to 10^{10}) in a range of channels specified by the user.

DEVL

Computes the amount of deviation of points about a survey line, in other words, the noise in the position data. There are two basic modes for computation of this quantity; transverse and longitudinal. Both modes require a computation interval to be specified and an amount by which this interval is shifted along the survey line.

The transverse mode computes a straight line of best fit through the points in a computation interval and then returns the standard deviation of the points about the line. If too long a computation interval is used, then the standard deviation will include a component due to real deviations in the ship's track. A suitable interval to use should be no more than 10 ship lengths. Experiment with this. The transverse mode therefore indicates the amount of sideways "jiggle" in the points about the nominal line of the ship's track. The transverse mode will work on either *.DAT or UKOOA files.

The longitudinal mode computes the deviation from the nominal station spacing along the ship's track. It doesn't compute the station spacing; you have to supply it. The length of the computation interval is probably not critical and the program reports the standard deviation in the direction of the ship's motion for each line. The overall figure for the whole survey is only correct if the nominal station spacing does not change from line to line. The longitudinal mode is presently set up to work on UKOOA files only.

DSPN

Reads a UKOOA file and produces a file containing the cumulative distance along each line and stats about station position. Supply a way point file if distance from SOL is desired. Specify source to antenna offset if the positions in the UKOOA file are given at the antenna, otherwise specify zero. The program was designed to check UKOOA files where the positions are given at the antenna or at the source. On output, the column headed ds1 is the difference between the nominal distance from 1st shot to current shot and actual distance from 1st shot to current shot. The column headed dsSOL computes distances to SOL rather than 1st shot.

DSUM, DIST

Reads some or all files in the time-based database and computes the number of line kilometres for each of the geophysical parameters. The user supplies the name of a survey definition file in the format of *SURVDEF.ASC*.

DTI

Computes the distance between succeeding points in a *.DAT file and reports any distances which are outside the range specified by the user.

DUKO

DUKO computes the differences between 2 UKOOA files. It was expressly written to compare a preliminary UKOOA file prepared from way-points, with a final processed file. Typically, the preliminary file will consist of 50 or so records, while the final file will consist of 1000's. These two files are referred to as the shorter and longer files. For the program to work, every spn contained in the shorter file must also exist in the longer file. The output log file will have a record for each of the input records of the shorter file. The columns are:

Line	- the name of the line
Shot	- spn
Bearing	- direction of travel taken over a 5 shot interval
Distance	- distance (m) between respective spn's
Direction	- bearing from the point in the long file to point in short file

EBASC

Converts an EBCDIC file to ASCII

EPCTIME

Reads a file created by DIGIT and deletes records which are within a specified time of the previous record. Note that SALVG will not deal correctly with a digitised file whose interval between records is less than the sample interval of the data file.

FIDSPN

This program is used to define a relationship between two sets of shot numbering schemes for UKOOA files. For example, one file may have shot numbers based on the field file identifier (ffid), while another may have a new shot number allocated to each shot. FIDSPN works through one file a record at a time and finds the corresponding record in the other file which is nearest in time. It then reports the shot numbers for these two records.

GRDASC

Converts binary format grid file produced by GRID to ASCII format to be read by Petroseis.

GDAS2DAT

GDAS2DAT reads the log file output from program GDAS (a DOS program available from the NGDC CD-Rom) and from it, obtains the NGDC survey-ID and the names of the files which are to be converted from MGD77 format to VAX binary format. When running GDAS2DAT, the GDAS log file and all downloaded MGD77 files should be available in the same directory [when initially running GDAS, search the CD-Rom for all surveys between 0-90S; 90-180E, then choose the option which lists the summary output by survey rather than by institution]. GDAS2DAT reads *survdef.asc* and determines whether each survey already exists in the AGSO time-based database by matching the first four characters of the survey ID and only converting survey files which do not match. Output survey numbers are automatically chosen by determining available survey numbers. A summary file, in survdef.asc format, is produced in the working directory which lists the survey files added. After the program is run, the processor should edit *survdef.asc* and check that the survey numbers do not already exist within the file before inserting the summary block - they shouldn't. Once verified, the time-based files may be copied into the database.

GRID

- Extracts data from the database and computes a smoothed grid of values which can be viewed with GMAP after conversion to IEEE binary format. The conversion program is GRIDCON.
- User specifies criteria upon which the selection is based.
- The cell size is the side length of each square grid cell.
- The radius of acceptance defines the boundary beyond which no data values are accepted. Set to 0 to accept all values.

GRIDCON

Convert VMS floating point file produced by GRID to IEEE binary format for display on the PC with program SEASAT.

GSHIFT

Adjusts a geophysical file for time lag errors in the gravity data.

HPUTWD

Creates a DISCO "HEADPUT" file (containing water depths) from an AGSO UKOOA file.

INFO

Gives basic information about a binary file.

ISECT

Computes the intersection points between seismic lines in a UKOOA format file. This file may contain embedded headers as well as data from multiple surveys.

ISOGAL

Convert gravity data from Isogal 64 to Isogal 84. Both input and output data are in micrometres/s/s. See also GRISO.

JUMPS

Seek and correct jumps in a channel.

LCUBE

Compute the latitude and longitude limits of a survey binary file. LCUBE will do either a single file, or multiple files. If multiple files are to be done, prepare a parameter file of file names, without the .DAT extension. For example, LCUBE will read the survey definition file *SURVDEF.ASC* and produce a log file of the output.

LINLIM

This program checks the spatial and temporal limits of seismic lines given the start/stop times in *SEISLIN.ASC.*

MAKEDB

MAKEDB creates an ASCII equivalent database for the time-based data. The program is currently set up so that data are output in UKODAY format with optional positioning formats in either decimal degrees or DMS. The program will read a control file (in survey definition file format) and convert, from the [nsp3.ti] database, each existing time-based file specified into an output directory.

MAKDEF

Create a clone of *SURVDEF.ASC* by searching all files listed and setting the D,G,M flags according to whether data exists. IF *SURVDEF.ASC* has D and G and M flags set already, then MAKDEF doesn't bother checking the file. If *SURVDEF.ASC* has any one of these flags not set, then MAKDEF searches the file until it finds at least 10 good values before setting the flag. MAKDEF can therefore be used to create a custom survey definition file. The output is to a log file.

MAKLNK

Create a command file LNKALL.COM, designed to link each program in the NSP program library. This program reads the *NOSDAP.CLD* file in the appl$soft:[nsp$soft.prog] directory to obtain the list of available programs. It takes no input run string.

MAPGRIDS

MAPGRIDS converts between grid and spheroid coordinates. It uses a control file for all input parameters and takes its data from an input data file. It writes the converted coordinates to an output file G_MAPGRIDS.DAT.

The control file has 6 or 7 records, as follows:

Record 1	integer code for mapping system (-1 to 39, 999)
Record 2	character*64 label for identification purposes
Record 3	three integers, each 0 or 1
Record 4	TM zone number, or grid to grid transformation parameters
Record 5	data file name
Record 6	format of data file
Record 7	three integers for datum, mapping grid and projection (only required for system 999)

The codes for the mapping systems and examples of control files are given in the first 440 lines of the source code and can be printed out by the systems person. There is also a manual by the author of the program, S.T. Mudge, called "Handbook for users of the program MAPGRIDS", 2nd version, 1992.

Note: MAPGRIDS.F77 is the original source code; MAPGRIDS.FOR is a modified version of the source code used to make the *.EXE file.

MASK

MASK reads a binary file and allows the user to delete records whose lat/long data fall within a specified rectangle.

MATTHEWS

Apply Matthews correction to water depth data derived from echo sounder measurements in Australian region. The speed of sound in water depends on its density, hence salinity, pressure and temperature. The Matthews tables provide corrections to be applied to echo sounder data (see Matthews, D.J. "Tables for the Velocity of Sound in Pure Water and Sea Water", 2nd ed, 1939, AGSO Library Pamphlet 7172).

The program uses cubic polynomial functions fitted to the Matthews table values in Region 64, chosen as the best approximation to Australian conditions of salinity and water temperature. The functions are:

For $300 < d_o < 3900$ m

$$d = d_o + (4.39 - 0.393\ d_o/10 - 0.000314\ d_o^2/100 + 0.0000009972\ d_o^3/1000)$$

For $3900 < d_o < 7000$ m

$$d = d_o + (8.1414 - 0.124371\ d_o/10 + 0.00014233\ d_o^2/100 + 0.00000032087\ d_o^3/1000)$$

where d_o is the observed depth and d is the corrected depth.

M77DAT

Reads an MGD77 format file and extracts the relevant data to make a VMS floating point 8 channel file. Supply the MGD77 filename, the survey number of the output file, a Y/N flag to indicate whether interpolation should be carried out and the number of seconds over which to interpolate. If the interpolation flag is set to 'N', then the interpolation interval is used as a screen output frequency. The companion program (which reverses the process) is DATM77.

MGDHED

Reads a file of concatenated MGD77 headers and produces a log file containing survey id number, NGDC number, year of surveys, institution and platform name.

MGDWD

Extracts water depths from MGD77 file and creates an ASCII file in a format for input into Petroseis. The file should contain header records as follows:

```
LON 03 10 0 *LATITUDE
LAT 13 20 0 *LONGITUDE
NUM 23 30 0 *NEG WD
NUM 34 40 0 *POS WD
INT 48 50 0 *?
INT 59 60 0 *?
#
```

followed by the data records.

MNEG

If the value in a particular channel is x, then MNEG allows the user to set the value in that channel to -|x|, ie regardless of whether the values are positive or negative, all values are set to negative.

MRGPOINT

A Windows program which computes the closest points between a pair of lines in UKOOA format. Used for finding the merge point. Also written as a FORTRAN routine, this program determines the most proximate shot point between a pair of lines in UKOOA format. The program accepts a control file in the format (a16,x,a16) which defines the pairs of linenames to be compared. The file accepts one linename pair per record and a maximum of 20 lines.

MSTATS

This program reads the output from program CRUX and generates data on mean mistie for all survey combinations. The user can exclude 1-1 combinations, or exclude other combinations. The result is written to the log file in the user's login directory.

NAV2NRP

Translates the position of the navigation from the antenna to Navigation Reference Point (NRP). The program asks for the in-line and transverse antenna offsets. It assumes the antenna is aft of the NRP (changed on the S189 survey) and to the port side of the centreline of the ship. If heading data has not been processed, the course will be used by default.

NZUKO

NZUKO does a coordinate transform of position between NZ49 <-> WGS84 datums for a file in UKOOA format. There is also an option to output the navigation in grid coordinates.

PATH

Compute distance between two points. Three methods are used. The user enters geodetic coordinates and the program converts these to geocentric coordinates for calculations on the sphere. The four inputs are all floating point values, so the user may enter degrees and minutes, or decimal degrees.

The great circle method gives the exact shortest distance between two points on a sphere. The other two methods give the rhumb line distance, which is measured along a path of constant bearing. Method 2 has been verified as exact.

P12UK

Convert a P1/90 UKOOA format file to an AGSO modified UKOOA file format. (Headers will have to be created manually).

P190

Convert an AGSO modified UKOOA file to P1/90 UKOOA format. A set of headers which conform to the P1/90 specifications should be manually inserted at the top of the file.

PICK

This Windows program allows the user to pick times or values from a binary data file. Three output formats are possible:

- start/stop times as a control file for PSMAP

- times, depths and gradients for Law of the Sea base of slope analysis
- times and water depth value as a control file for SALVG

The program only works on a 9 channel file using channel allocations as in final data files, ie position in 3 & 4, depth in 5 and so on. Furthermore, the program is designed to read IEEE binary format data, so files created on the VAX need to be converted to IEEE format using program VAXPC first.

POLYMAKE

This program creates a polygon file from a set of digitised line segments. The program ensures that the lines that are common to two polygons, are identical. Related programs are SUMMARY and REVERSE.

PUKOUT

PUKOUT Produces a pseudo-UKOOA file from a time-based binary file. The shot number is the number of running minutes in a year. See Appendix 2 for format of the output file. See also UKODAY.

QCDATA

Extracts compass and related data from the 700-channel, binary QC file. This program is used in preference to SWAP, because the QC file contains integer as well as floating point fields.

RANGE

Reports records within a specified range. Use as follows:

$ RANGE input_file/OUTPUT=log_file/CHAN=chan_num/MAX=max_value/MIN=min_value

The OUTPUT qualifier is optional.

REFn

A series of reformatting programs based on REF_ASC.

REF1 - Converts John Marshall's bodgie Excel file from Survey 134
REF2 - Converts Sonne ASCII file
REF3 - Converts an ASCII line file from Petroseis to a *.DAT coastline format file
REF4 - Converts *.DAT coast file to *.ASC file for Petroseis
REF5 - Converts seismic processing shot file so that last shot of set is used
REF6 - Converts *.ASC to *.ASC
REF7 - Converts *.ASC file to *.DAT file
REF8 - Convert Master Names File (MNFAUST.ASC) to place names file POPL.ASC

REF9 - Convert Start/Stop file *.ASC to *.ASC
REFA - Change the name of all lines in a UKOOA file
REFB - Convert a sample station file
REFC - Convert a NOPEC UKOOA file to AGSO UKOOA
REFD - Convert ASCII to DAT
REFE - Reformat a shot times file by interpolating between first and last shot
REFF - Convert a file containing degrees to decimal minutes
REFG - Reads a binary file and writes an ASCII file with time, position and one parameter
REFH - Read DAT and convert decimal degrees to radians; write DAT
REFI - Convert *.DAT file to *.ASC shot times format
REFJ - Convert shot-indexed *.DAT file to *.ASC modified UKOOA format

REF_ASC

Reformat an ASCII file. Get the programmer to modify this program to suit your needs.

REFWELL

Reformat a Petroseis well location file.

SCAT

Computes the standard deviation (σ) of position data in metres about a straight line. The program works on 2 adjacent channels at a time and the standard deviations in metres can be output to a data file.

Option T works out σ's for latitude vs time and longitude vs time.
Option P works out σ's for latitude vs longitude and longitude vs latitude.

SEASAT

Windows program to view grid files, including the Haxby and Sandwell world gravity grids, as well as files produced by VMS program GRID followed by conversion by GRIDCON.

SHOTDIST

Reads an AGSO modified UKOOA file and reports duplicated shotpoints and inter-shot scaled distances (distance/SP) which lie above a user-specified threshold value.

SINFO

For information about a file in the digital database.

SNUM

Change the survey number for a survey file.

SP_INTERP

Fills gaps in shotpoint numbers in a UKOOA format file and interpolates the navigation across the gaps.

STI

Computes speed, smoothed over a number of samples.

STIM

Create a control file for PSMAP for UKOOA files. Works similar to GDAT and CTIM.

SUMS

Similar to MATHS, except input is by run string, allowing sets of files to be worked with more easily. Operations are single precision. Add(+), subtract(-), multiply(*), divide(/) or raise to a power(^) a channel of numbers by a specified number. The run string is:

Input file, output file, operator, number, channel

where operator is one of +, -, *, /, ^ and the operation is defined as:

output value = input value <operator> number

TIEWELL1, TIEWELL3

These two programs read a UKOOA file and determine a list of all wells which lie within a user-specified distance of the seismic lines. Other information such as the nearest distance of each of the selected wells from the lines is determined as well as its corresponding SP number. The procedure is as follows: change directory to pathworks:[ralmond.prog1.for.tiewell]; use ftp to copy the latest version of tiewells.asc from **carbon** at /export/mpsr/gq1h/cul/ascii; type **run tiewell1** and enter the name of the UKOOA filename and proceed to answer the questions, enter the name of the tiewells.asc file; type **run tiewell3** and answer the questions as above, enter the output file from tiewell1 and then give names for 3 output files.

TIMOUT

TIMOUT creates an ASCII file in a basic product format from standard eight channel binary time file. The program calculates bouguer gravity, after the user specifies the density.

TRIM

Set extreme values to 10^{10} and delete unwanted data in entire channels.

TSHIFT

Applies a time shift to the data file. The user supplies the distance corresponding to the amount of time shift required.

TURNS

Determines the turns in a ship's track and returns the straight line segments for further processing. (A bearing difference of 2.5 degrees between 1-minute data samples has been empirically determined as the value which indicates a significant change in the ship's track.) This program is not foolproof, however it effectively determines most of the straight line segments.

UK2SSP

Processes a UKOOA file to produce the location of each shot at the seismic stack point, SSP (commonly at the source or midpoint position) from the ship's position (at Nav Ref Point, NRP). The processor enters the source-ship distance and the source-neartrace distance. If the SSP is required at the source position, 0.0 should be entered for the second parameter. UK2SSP has a similar effect to program DELAY and therefore should not be run when DELAY has already been used in the process.

UKGAPS

Reads a UKOOA file and computes the shotpoint ranges for each seismic line over which there is a continuous gap in the bathymetry, gravity and magnetics data.

UKLABS

List all line labels contained in a UKOOA file with start/stop shots, times and lat/longs produced for each line. Options are included to read AMG coordinates, list headers and provide data ranges. An option exists to create a listing of the start/stop times for each line for direct insertion into the *seislin.asc* control file. This file is produced in the working directory and it's name is of the form SEISnnn.ASC, where nnn is the survey number. *It is assumed the input UKOOA file name follows the database file-naming nomenclature and has it's survey number in columns 2-4 and survey part number (if it exists) in column 7.*

UKMAP

Windows program to view a UKOOA format file.

UKODAY

Reads a binary file with standard database channel allocation and writes an ASCII file which can be used to input into Petroseis. The ASCII file contains a field with decimal hours*100 and this can be used as a pseudo-shot. The line name can be taken from the first 8 columns and is ssss/ddd. As well as total gravity and magnetic field and IGRF and free-air anomaly data, bouguer gravity is also output after the user supplies a density. The output format is the same as for program MAKEDB.

The program is similar to PUKOUT, but does not take a start/stop file.

UKOLL

UKOLL computes lat/lon geodetic coordinates from a UKOOA file containing UTM coordinates as Eastings/Northings. The output has not been set up as a UKOOA format file. Supply the name of the input file and the UTM zone in the run string. (The program was hacked from MAPGRIDS).

UKOPART

Extracts some lines from a UKOOA file. Make up a list of line names as a parameter file and the program will ask you if you want these lines included in or excluded from the output file.

UKOXY

UKOXY (same as XYDATA) computes UTM coordinates from the geodetic lat/lons in a UKOOA file. The input file may have header records, in which case the output file will have modified header records. The output file will be a UKOOA file with eastings in columns in 45-52 and northings in columns 53-60, thus overwriting the gravity data.

The user must supply the name of the input file, the UTM zone and the reference datum (WGS72 or WGS84).

UTM zones are 6° wide and numbered from 1 to 60. They are valid from 80°N to 80°S. Zone 1 is the band from 180°W to 174°W and subsequent zones are to the east of this zone. The origin for each zone is the point of intersection of the equator and the central meridian. For the southern hemisphere, this point has coordinates 500,000E and 10,000,000N

The relationship between the UTM zone and its central meridian is:

$$c = 6z - 183$$

where c is the central meridian and z is the zone number.

Most AGSO surveys will cross UTM zone boundaries, so the user should be careful in choosing the central meridian and hence the zone number.

If computational laziness strikes, execute the first stage of PSMAP and it will report the UTM zone for the map area you specify.

VAXPC

VAXPC converts a VAX/VMS floating point file to IEEE format used on DOS machines. Simply supply the names of the input and output files.

VERSION

VERSION lists all files in the time- and shot-based databases which have either been created or modified since a user-specified date.

VMSWD

Reads a VMS floating point file (8 channels) and writes an ASCII water depth file (for use with Petroseis). The file should contain header records as follows:

```
*PS-LINE     01 10    - Pseudo line name (optional)
*PS-SHOT     11 20    - Pseudo shot number (optional)
*LATITUDE    21 30    - Latitude
*LONGITUDE   31 40    - Longitude
*DEPTH       41 50    - Water Depth
```

WDOUT

Reads an ASCII file of line name, time and depth (or some other value) and a binary data file of time and position (such as a 1 minute floating point file) and assigns positions to the depths. Output is a pseudo-UKOOA file.

The program may be used with a concatenated data file from several surveys.

WGS7284

WGS7284 does an interchangeable coordinate transform between WGS72 and WGS84 datum for a single navigation value.

WGSUKO, WGSDAT

WGSUKO does a coordinate transform of position from WGS72 to WGS84 for a file in UKOOA format. WGSDAT does the WGS72->WGS84 transform for data in binary form.

XTIME

Read a binary file and skip records which have bad times. The run string parameters are input file name, output file name and survey number for the file. The program only checks channel 2 for bad times. Bad survey numbers (in channel 1) are replaced with the appropriate survey number.

XYZTRIM

This reformatting program reads an ER-MAPPER grid file in ASCII format and removes null values.

12. Redundant Programs

ASCDAT & DATASC - Convert an ASCII data file to a binary data file and vice versa.

ASCDAT will read the ASCII data file in the format specified by the header. (See *File Types and Structures*) and produce a binary data file with records having the same number of values. To produce a binary data file with some extra channels add some dummy format specifications to the end of the header (but before the line with the #) and change the # number to the new number of fields. To produce a binary data file with less channels delete some lines at the end of the header (but before the line with the #) and change the # number to the new number of fields.

DATASC will read the specified binary data file (and its header file which is in the [.HED] directory) and produce an ASCII data file according to the information in the header file, thus the format of the ASCII file can be controlled by editing the format specifications in the header file before running DatAsc. Note, though, that the number of channels specified in the header file must match the number of channels in the data file that it describes.

An example of header records of an 8 channel file:

```
AGSO Survey 110 final data

F7.3        Survey.Julian day    (sss.ddd)
F8.6        UTC                  (.hhmmss)
F9.7        Latitude             (radians)
F9.7        Longitude            (radians)
F8.1        Depth                (metres)
F9.0        Gravity              (µm/s2)
F8.1        Magnetic Field(nTesla)
F8.1        blank
#008
```

The data records are fixed length and contain as many fields as are specified in the last header record. All fields contain floating point numbers or asterisks if there is no valid value.

ATMIN - Some processing methods from clients produce 1 minute positions, but not at the whole minute. This program reads a binary file of time and position and interpolates the positions to the whole minute.

CALC - Simple calculator. Type CALC and follow the instructions.

COMMENT - Program to "comment out" multiple shotpoints in final seismic navigation data.

COAST - Program to examine floating point coastline files.

DELTA - DELTA produces a pair of channels containing the difference between succeeding samples in the latitude and the longitude. (These differences are often referred to as delta-lats and delta-longs.) The differences are expressed in terms of radians.

- The input data is either a pair of channels containing the longitude and latitude, or 3 channels containing the ship's heading, fore-aft speed and port-starboard speed. Up to 3 operations using inputs from different systems can be performed in a single run of the program.

- DELTA formerly computed deltas in nautical miles.

- The output from DELTA is integrated with SUMLL then tied with QDR (see 11. Miscellaneous Programs).

DPREC - Test speed of double precision computation.

FINDX - Computes the intersection point between the positions given in two lists and the misties in up to 10 channels. FINDX reads the lists starting at the times specified in the menu and continuing for 20 samples. Thus, give start times approximately 10 samples before the estimated intersection times. The details are reported to a log file if required.

GCOUT - A version of UKOUT which creates an ASCII file of geochemistry data at the shot. The input data file is typically a binary file of geochemical data with time intervals of approximately, but not exactly, 2 minutes.

GRISO - Program to convert between gravity datum's, using the 'long' formula, not recommended by gravity group. See also ISOGAL.

HPVAX - To convert a HP floating point file to VAX floating point format. First enter the HP file into the VAX system using the steps in the Notes below.

To enter a HP floating point file into the VAX system, do the following:

- Mount the HP tape on one of the drives connected to GARP2. The operator will call you when this is done and tell you the drive name. In the following, the drive name MUA0: will be used.

- Logon to GARP2.

- Calculate *number_of_bytes*, which is the number of bytes per block, for which the maximum allowable is 32768. Calculate *number_of_bytes* by multiplying the block dimensions by 4.

  For example, if FILIO produced a tape blocked 64 x 12, then,
  number_of_bytes = 64 x 12 x 4 = 3072.

- $ MOUNT/FOREIGN/BLOCK=*number_of_bytes* MUA0:
- $ COPY MUA0:*file_name* (*file_name* is the destination file name)

If copying files from tapes with eof's , eg: files with headers then,

$MOUNT/FOREIGN/BLOCK=*number_of _bytes* MUA0:
$COPY/LOG MUA0:*.* *filename*.HP

This should create log files FILENAME.HP;1 and FILENAME.HP;2

If an error occurs, repeat the copy command and the tape reading should continue.

- $ DISMOUNT MUA0:

ARCH2 FILES

If you have an ARCH2 tape from which you want to extract data, then mount the tape and specify a BLOCK qualifier greater than the largest block dimension expected, eg 9000.

$MOUNT/FOREIGN/NOASSIST MUA0:/BLOCK=*number_of _bytes*

If you don't do this, you will get a "data overrun" when you try to read the first file.

Then copy individual files from the tape.

$COPY/LOG MUA0:*filename1*.HP
$COPY/LOG MUA0:*filename2*.HP
$COPY/LOG MUA0:*filename3*.HP
$COPY/LOG MUA0:*filename4*.HP
etc

The first 6 characters of the output files will contain the ASCII name of the file.

If the file you are interested in is a floating point data file, HPVAX will convert it, skipping the first record which is a file header. Take note, however, of the following:

If, after running HPVAX, you notice that there are regular gaps in the output file, check that you have chosen a number for *records/block* such that *records/block* x *number of channels* is a factor of the block length of the HP file as copied to VMS. To get the block length of the HP file sitting on your VMS disk:

$DUMP/RECORD filename.HP

The block length of any VMS file will be a multiple of 512 bytes. Now, when specifying the block dimensions of the HP file to HPVAX, make sure that *number of channels* x *records/block* is a factor of the block length of the file.

Example:

Say you were reading a 32x24 file from the HP and in order to be able to read it from the ARCH2 tape you had to specify /BLOCK=9000 such that VMS used 8192 (=512 x 16).

Then, to get HPVAX to read the file properly, you could specify Records/Block = 64 because 32 x 64 = 2048 and 2048 is a factor of 8192.

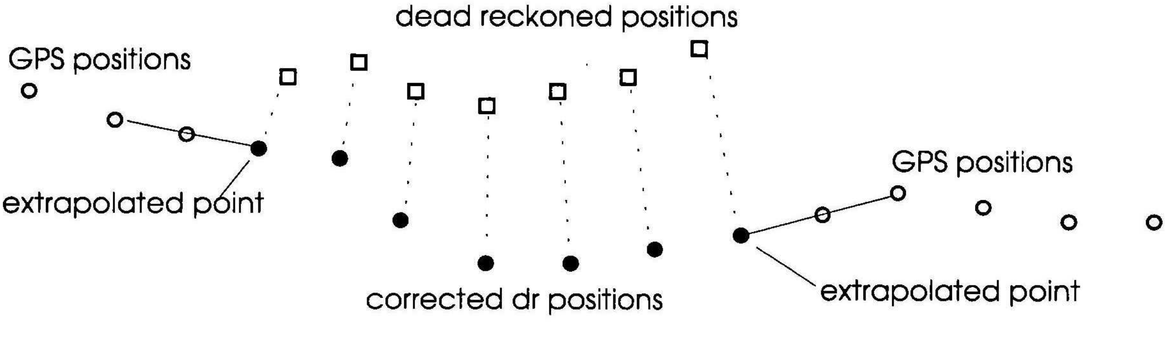
INTEG - Integrate up to 3 pairs of delta-lats and delta-longs to form latitude and longitude channels.

MAV - This is a moving average filter which allows for tapering of coefficients from the centre of the window to the edge. The I/O of the program is modelled after SMTH.

NOFFS - This program takes as input a towleader/nearoffset file containing time, linename and near-offset data and a speed file containing time, linename and speed. The speed file is the output file from program SPEED. NOFFS synthesises a correction file from the two input files as input into program SPNDT.

The current format for the towleader/nearoffset file is F10.6, 3X, A10, F8.2. 20/08/93

QDR - Ties position data derived from dead reckoning over an interval, to known positions one sample either side of the interval. The program extrapolates good positions 1 sample into the interval to determine the tie point. The diagram below illustrates how QDR corrects the dead reckoned positions:



With the advent of differential GPS, dead reckoning is very rarely used. At the time of writing, the last use of dead reckoning was for a 1 hour period from 107.012.091300. The following process can be applied:

- Obtain Magnavox and Raytheon speed logs for fore/aft (F/A) and port/starboard (P/S) and heading. The units for the speed logs will be "clicks" and for compass will be degrees.

- Obtain good (ie dGPS) position data on either side of the interval during which dead reckoning will be used.

- Smooth speed log data with SMTH.

- Find out the conversion factor clicks/nm for Magnavox and Raytheon. Convert clicks to speed in knots using the MATHS difference option. For example, if the Magnavox was calibrated at 4800 clicks/nm, then the multiplication factor used in MATHS (DIFFERENCE option) will be 0.075. That is to say, if "delta" is the number of clicks per 10 sec, then,

  speed = delta clicks/10s / 4800 clicks/nm * 360 10s/hr

  or speed = delta * 0.0175 knots

- Compute incremental latitude and longitude in radians using DELTA. These will represent the change in position over each 10 sec period.

- Integrate the incremental latitudes and longitudes using a suitable starting value with SUMLL. The starting value need not be exactly at the tie with the end of the GPS section. This will yield the dead reckoned positions.

- Tie the dead reckoned positions to the dGPS ends with QDR.

- Resample to 1 minute with RESAM.

SALF - Reformat an ASCII file. Needs to be set up by the system programmer for the particular job. Originally created for reformatting to suit SALVG.

SORT - Test of mergesort routine in [.msc]

SPEED - To provide a file of ship speed changes for input into program SPNDT.

The program computes the average speed of the ship from a given speed channel. It outputs speed changes with time when speed thresholds are exceeded. The first threshold is the difference between adjacent speed averages. The second is the difference between the current and last reported average. Statistical information is reported to a log file.

The line times file is taken as input to provide the start/stop times for each of the lines in the survey.

- Speeds are averaged over a given window length. Windows are non-overlapping.

- All speed and associated computations take place within the start/stop ranges specified in the line file.

- The output time is in the middle of the window.

- It is suggested that values between 0.2 and 0.5 knots be used for the threshold and the number of samples be chosen between 10 and 20 for a 10-sec file. These values should be varied when the number of speed changes is either too small or too high. (A good starting point is as per the speed box above.) If the speed data is very noisy, pre-processing of the speed data may be considered (eg. smoothing or PCEDAT).

- The second threshold is set internally at 1.2 times the first threshold.

- The maximum allowable number of points to be averaged is 1000

SPNDT - To make a correction to the shot-times file so that position is specified at some point astern of the antenna.

The shot-times file gives the time at each FFID, or shot. The position at this time will be the position of the ship's antenna. Seismic processing transforms the "FFID" into an "SPN" which will be at some point astern of the antenna. This point will be either at the source, or at a point mid-way between the source and the first group. The position given in the final UKOOA files must therefore be specified at the time the ship would have been at the SPN. This amounts to a correction to the times given in the shot-times file.

In order to compute the correction, the user must input the ship's speed and the distance from source to the first group (near-offset).

- The program takes an optional input (S/T) to compute the change in time value based on shot or time input
- The corrections file must have the format a10, i6, i6, f6.1 for line name, SPN, near-offset (m) and ship speed (kn) respectively if option S is chosen.
- The corrections file must have the format a10,f12.6,i6,f6.1 for line name, time, near-offset(m) and ship speed (kn) respectively if option T is chosen.
- The corrections file should have a record for each change of ship speed or near offset.
- The SPN given in the corrections file must exist in the input (shot-times) file.
- The time given in the corrections file must exist in the input (shot-times) file.
- The first record in the corrections file should have the first line name and first SPN given in the input file. The last record should have a non-existent line name. All other fields should have valid values.
- The format of the shot-times file (the input file) must be DAS format (See Appendix 2).
- The output file will have the same format as the shot-times file.
- Usually the source offset is 82.75 m. (NOTE: Source offset = 95.75m for S118)
- NOTE: The program can have problems if successive entries in the corrections file are separated by less than about 20-30 secs. Once identified, one (either the first or second) entry can be edited out of the corrections file.

SPNFIX - Fix specific problems in the shot-times file.

SPREC - Test speed of single precision computation.

SUMLL - Integrates incremental latitudes and longitudes output by program DELTA or INTEG. The input data must be in radians, positive to the north and east. The user has the option of tying the first point in the interval to a specific latitude and longitude. These values must be given in radians, using 100 degree bias for longitude.

WDBX - Convert World Data Bank coastline data format to Petroseis format.

XTRACT - To extract files from a concatenated ASCII file. This program has been used during the transfer of data files from the HP to the VAX.

- XTRACT accepts as input a composite ASCII file, which contains several discrete files.

- The files are separated from one another by a record with '?' in column 1 followed by a 3 digit number.

- XTRACT outputs the discrete files. The names of the output files will be XnnnXX.ASC where nnn is the 3 digit number following the '?'.

- A typical program which generates a concatenated file is the HP program FAC1, which displays binary files on the screen for down loading to a PC via PROCOMM.

13. Processing Applications

The following section describes the essential processing steps and sequences which have been used to solve particular processing tasks and problems.

Example of Seismic Streamer processing

Compass, source and tailbuoy positions are the data used to process the seismic streamer location at every shot. During acquisition, compass data are written to a 700-word binary format (QC) file, while tailbuoy data are written to the DAS file. The following procedure describes the method developed to first compute the streamer position and then individual receiver positions.

1. Compass Data

QCDATA - Extract data from the QC file.

ATSEC2 - Interpolate to the 10 second mark.

FIXTM - Correct time order errors. Iterate this process once or twice until there are no remaining time gaps.

FTAPE - Interpolate the data over gaps of up to 3 minutes.

2. Tailbuoy Data

SWAP - Extract the tailbuoy latitude, longitude and time information from the DAS file.

XTIME - Omit records containing bad times.

FIXTM - Time order errors are corrected.

FDATA - Despike the data. A window of 5-10 samples and a threshold of 1.5e-6 radians may be applied.

FTAPE - Interpolate the data over gaps of up to 10 minutes.

PCEDAT - Interactively edit the data to remove or modify obviously bad values.

FTAPE - Smooth the data by applying a sinc function filter.

3. Compass, Heading and Course Data

MERGE - Merge compass data from process **1.** with course and heading information (from DAS file) into one file. The values are in degrees.

MATHS - 'Unwrap' compass values.

FDATA - Despike compass, heading and course data.

FTAPE - Interpolate data over time gaps of up to 3 minutes.

PCEDAT - Display all compass data on a PC-based editor and interactively edit obvious errors. Note any remaining time gaps in the compass readings and carry out an interpolation on a particular compass if it can be seen that other compass values are linearly varying at the times corresponding to where they were at identical locations to the compass being edited.

MATHS - Convert compass data back to modulus 360 values.

4. Compass Location Data

MERGE - Merge the final navigation into channels 3 and 4. Tailbuoy data from **2.** are also merged into the file.

COMPASS - Calculate each compass location in dx and dy coordinates (origin defined at the back of the boat). The algorithm assumes that the streamer is rigid between compass locations and that it's location is given by extrapolating from a compass location with a gradient given by the compass angle at that point, for a distance equal to the inter-compass length. Heading and course information are used in the calculations.

FDATA - Despike dx, dy values. The parameters chosen are a window of 6 samples and a 1m threshold.

SMTH - Smooth dx, dy values using a sinc function filter. The parameters used are 3 zero crossings and a 3 minute period.

CABLE - The latitude and longitude positions for each compass are calculated.

5. Compass Location UKOOA file

UKOUT - Combine the ship, compass and tailbuoy position data with the 'pre-delay' shot times file to make a modified UKOOA file containing the positions of the ship, compasses and tailbuoy.

ANT2SRC - Insert the shot location (at the seismic stack point) from the 'delayed' shot UKOOA file into the compass location file.

ADJUST - Adjust the compass positions by rotating the line between source and last compass location, by pivoting around the source, to the line between source and tailbuoy location.

STRUKO - (Optional) Convert source, compass and tailbuoy data from WGS84 to AGD84 datum.

FILT_REC - Omit all records with any inter-compass distances differing by more than 30 metres from the expected distance.

EXTRAP - Extrapolate shot locations for all missing records from SOL and up to EOL.

6. Shot/Receiver positioning file

GENRATE - This program is used to generate a file containing geographical and rectangular coordinates for (i) each shot and (ii) all receiver locations on the cable for each shot in the survey. The coordinates are computed by evenly interpolating the receivers between compass locations. The output is produced in either modified UKOOA format or Petroseis format, where each line-shot combination is represented as a unique line name. In the Petroseis format, receiver labels are numbered from 1 to R+1, where 1 represents the source location, 2 represents the receiver closest to the ship and R+1 the receiver furthest from the ship (R is the number of receivers in the cable). The program interpolates shot and receiver locations across missing shotpoint ranges in the compass location file. **Note:** This receiver numbering convention was chosen as Petroseis does not accept an input shotpoint number of 0.

CHKREC - Check the shot/receiver file created by program GENRATE. Print start/stop shots for each original linename, report any discrepancies in the distance between receivers within the streamer and report discrepancies between adjacent shot locations.

7. Water depths at receiver locations

PETROSEIS[5] - The following steps are followed within the Petroseis package.
(1) Create a seismic master file for the UKOOA shot data.
(2) Import the UKOOA file containing navigation and water depths into the seismic master file.
(3) Convert geographical positions to AMG coordinates after choosing the appropriate UTM zone.
(4) Grid the water depths on a map sheet covering the seismic area.
(5) Create a new seismic master file for the seismic streamer data.
(6) Import the shot/receiver file into the seismic master file. First format the file so that the streamer at each shot is given a unique name, which is made up by combining essential elements of original linename and shotnumber. Each streamer is therefore represented in Petroseis as a "line", each with a "shot point" range of 1 to R+1, where R represents the number of receivers on the streamer. The number of lines created is equal to the number of shots in the survey.
(7) Convert geographical positions of the shots and receivers to AMG coordinates using the same coordinate transformation parameters from step 3.
(8) Use the "back-interpolate" option to attach a water depth value to each receiver location by interpolating from the grid. As a check, the receiver water depths may be used to produce a grid by using the same gridding and display parameters from step 4.

AWK - Reformat the line/shotpoint information back to their original line names and shotpoint numbers. Renumber the receiver labels if necessary.

PSMAP - Plot the streamer location from either the compass location UKOOA file or the shot/receiver file produced by program GENRATE.

[5] Product of Petrosys Pty. Ltd.

Procedure to determine the seismic line intersections of all AGSO data from a particular area

UKOINFO - Create a file containing a seismic line definition for each seismic line for all specified surveys in the shot-based UKOOA database. These surveys can be selected according to class of survey or whether normal, reprocessed or both types of data files are to be included. If all AGSO surveys are to be included use *SURVUKO.ASC* (alternatively edit this file to suit the requirements).

SINFO - Run this program on the particular survey to be analysed to obtain it's lat/long limits.

XSEIS - Run this program over the lat/long limits determined and use the seismic line definition file produced after UKOINFO (above) as input. Use the 'P' option to only include the data in the particular area of interest. This program will produce an ASCII file of all data in the area.

ISECT - Read the output file from XSEIS as input and determine all the seismic line intersections.

Example of shot resequencing after extracting shot-times information from seismic field data tapes

UKOUT - Combine the shot-times file with the binary navigation file to produce a UKOOA file. If the data is to be recovered from a DISCO log file (.mlf), then an awk pattern-matching script should first be run to extract the correct records and to correctly format the output file.

UKMAP (PC-based program) - Use this Visual Basic program to determine the location of gaps and overlaps in the seismic lines.

SHOTDIST - Analyse the file for the location of shotpoint gaps as well as distance/SP across gaps. If this average distance is in accordance with the shotpoint distance for the survey, SP_INTERP can be applied as the next processing step.

UKCHECK - Determine whether there are any shotpoint gaps or large inter-shot distances in the file. From this and the previous two steps, determine where to start resequencing the lines.

SPNUM - Resequence the shotpoint numbers if necessary. This will be necessary if two lineparts are to be joined to make one line or if there are shotpoint bunching problems etc.

SP_INTERP - Interpolate the navigation (and geophysical data) across shotpoint gaps in the file.

UK2SSP - First establish whether the navigation for the file is at the antenna, source or elsewhere. If the navigation is at the antenna, put the navigation back a distance necessary equal to the antenna -> seismic stack point (SSP) distance. This should not be run if DELAY has already been run during the process.

UKCHECK - Check whether the processed output file has correct shot sequencing and inter-shot distances.

Notes for processing of navigation data for ODP seismic site survey (AGSO Survey 169)

The S169 survey was shot in a 2D grid over a proposed ODP sampling site with most of the lines shot continuously around tight bends. As the acquisition software on board is only designed to handle straight-line seismic lines (between waypoints), the shot numbering was found to go 'haywire' on the bends. To get around this problem and to facilitate a method whereby the seismic contractor could process the non-standard survey in a conventional manner, the navigation and shot-times files for the survey were used to determine a cumulative along-line distance for each shot of each line. Each shot along the line was incremented by 1. The processors then took the data and "binned" the CDPs into 6.25m intervals during the sorting phase. The aim of the processing described below was to interpolate between the known location of the shots to determine the geographical coordinates and the geophysical data at 6.25m intervals along the ship's track. All NSP programs are denoted in capital letters.

Primary files

1. File containing linename, resequenced SP, position (in rectangular coordinates) and along-line distance data. This was the output file generated after X and Y data were computed using Petroseis.
2. Original file (ASCII dump of time-based file using UKODAY) containing the linename, new SP, original FFID, lat, long, water depth, gravity and magnetics.

Processing steps

1. Merge the along-line distances (using X,Y data) with the file containing the lat/longs and the geophysical data using ALD_MERGE.
2. Match the CDP locations (every 6.25m) with the along-line distance values above and then interpolate the lat/longs to give the location at each CDP (MATCH_ALD). The output from this program is in modified UKOOA format.
3. Run program CDP2SPN to resequence the CDPs to every 2nd shotpoint starting each line at SP100.
4. Run UK2SSP to determine the lat/long at the seismic stack point by interpolating between earlier shotpoint locations to place it a fixed distance behind the antenna.

Analysis programs

1. Use UKCHECK to check the UKOOA file for shotpoint continuity, inter-shot distances and shot intervals outside of a given range.
2. Use the PC-based program UKMAP to display the UKOOA data on the screen. Determine whether there any obvious overlaps or gaps in the SP data within the file.
3. Use SHOTDIST to determine the location of any gaps in the file and the average inter-shot distance across the gaps.

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Appendix 1 - Work Modules and Utilities

Conversion Utilities

AGD84	N. Johnston	Conversion between WGS84 and AGD84 datums
AGDUKO	N. Johnston	Convert UKOOA format file from WGS84 to AGD84 datum
ARCOUT	R. Parums	Converts UKOOA file to ARC/INFO input ASCII format
BLOUT	R. Tracey	Reblock an ASCII file
DSTO	R. Parums	Reformats UKOOA file to give water depths only
EBASC	R. Tracey	Conversion EBCDIC to ASCII
GDAS2DAT	R. Parums	Make multiple binary files from NGDC MGD77 files
GEBCO	P. Petkovic	Conversion Gebco CD-ROM export to Petroseis format
GRDASC	P. Petkovic	Converts GRID output file to ASCII for Petroseis
GRIDCON	P. Petkovic	Converts GRID output file to IEEE binary for DOS
ISOGAL	P. Petkovic	Convert gravity datum from Isogal 65 to 84
MACRAY	P. Petkovic	Conversion Petroseis section to MacRay format
MAKDEF	P. Petkovic	Make a new *SURVDEF.ASC* file based on file contents
MAKEDB	R. Parums	Create an ASCII version of the time-based database
MAPGRIDS	S. Mudge	Coordinate transformations
MGD77	P. Petkovic	Create binary file from ASCII file in MGD77 format
NZUKO	R. Parums	Convert UKOOA file b/w WGS84 and NZ49 datums
PUKOUT	H. Stagg	Convert time-based data to pseudo-UKOOA format
REF_ASC	R. Tracey	Reformat an ASCII file (see also REF1, REF2,...)
SALF	P. Petkovic	Reformat an ASCII file for SALVG
TIDY	D. Collins	Tidy file derived from HP system (See GETP & GETS)
TIMHIRES	R. Tracey	Convert binary file to ASCII in external product form
TIMOUT	R. Tracey	Produce standard ASCII file from binary file
UKODAY	P. Petkovic	Create pseudo-UKOOA format file from binary file
UKOLL	S. Mudge	UTM to WGS84 coordinate conversion (after MAPGRIDS)
UKOXY	S. Mudge	Spheroid to UTM grid conversion (after MAPGRIDS)
VMSWD	P. Petkovic	Read a binary file and produce ASCII point file for Petroseis
WDBX	P. Petkovic	Conversion WDBX format coastline file -> Petroseis format
WGS7284	R. Parums	WGS72->WGS84 coordinate transformation (single points)
WGSDAT	R. Parums	WGS72->WGS84 coordinate transformation for binary data
WGSUKO	R. Parums	Convert UKOOA format file from WGS72 to WGS84
XYDATA	S. Mudge	Code from UKOXY stripped to bare essentials

File Management

ARCHIVE	D. Collins	Copy disk files to tape (DCL program)
GETPROG	D. Collins	(Use GETP.COM) Extract program from ALLPROGS.ASC
GETSUB	D. Collins	(Use GETS.COM) Extract program from ALLSUBS.ASC
MAKLNK	R. Parums	Make a LNKALL.COM file for NSP program directory
MERGE	A. Parisi	Merge files
MLIST	D. Collins	List files

Database and Enquiry Utilities

COAST	P. Petkovic	Examine coastline file
GDAT	P. Petkovic	Extract data from database according to specified criteria
INFO	R. Tracey	Information about *.DAT files (see also SINFO)
LCUBE	P. Petkovic	Lat/long limits of a file
LINLIM	P. Petkovic	Compute spatial limits of the seismic lines in a binary file
LISTURN	P. Petkovic	Statistics on turns (under development)
LOOKTIME	R. Parums	Looks for an exact time match and returns record number
MGDHED	P. Petkovic	Extract info from concatenated MGD77 headers
QFIELD	P. Petkovic	Analyse the database FIELD table
RANGE	P. Petkovic	Reports records within a specified range
SINFO	P. Petkovic	Information about a file in the digital database
SPINFO	P. Petkovic	Return information about a shotpoint in a UKOOA file
STATS	D. Collins	Compute diagnostic statistics on a file
UKOINFO	R. Tracey/R. Parums	Outputs seismic line statistics for selected seismic surveys
VERSION	R. Parums	List all database files which have had mods since a given date
XFIELD	P. Petkovic	Create a unique index for the database FIELD table
XSEIS	R. Parums	Extract data from UKOOA database according to specified criteria

General Processing

ANOM	H. Stagg	Compute magnetic and gravity anomalies
ASCII_READ	N. Johnston	Read ASCII format file on 3480 tape cartridge (for ship)
ASCII_WRITE	N. Johnston	Write ASCII file to tape at 80 bytes/rec, blocksize 80 bytes
ATSEC2	P. Petkovic	Interpolate a channel to a timing mark (10 or 60 sec)
BADLL	R. Tracey	Correct bad lat/long
BATCH	D. Collins	Set up batch jobs (DCL program)
BLEND	P. Petkovic	Blend 2 channels of data into one output
CHECKST	P. Petkovic	Checks a shot-times file in DAS format for continuity (DOS)
CHECKST	R. Parums	Checks a shot-times file in DAS format for continuity (VAX)
CRUX	R. Parums	Compute intersection points in a 1 minute file
DDAT	R. Parums	Compute distance between 2 binary files (at identical times)
DELAY	P. Petkovic	Apply DELAY to shot-times equivalent to antenna-CMP dist
DELBAD	P. Petkovic	Delete bad data
DEVL	P. Petkovic	Standard deviation of points about a survey line
DIGIT	B. Goleby	Digitise an EPC water depth record
DSUM	P. Petkovic	Cumulative distance along track for geophysical parameters
DTI	P. Petkovic	Distance and speed between points along ship's track
EOTVOS	H. Stagg	Tie gravity and apply eotvos correction
EPCTIME	P. Petkovic	Correct DIGIT output file
FDATA	A. Parisi	Despiking filter
FINAV	H. Stagg	Blend navigation systems, tie gravity, correct for eotvos
FIXTM	A. Parisi	Correct time order errors
FTAPE	A. Parisi	Fill gaps in data files
GSHIFT	R. Parums	Shifts gravity data 1 minute to compensate for lag effect
IGPS	P. Petkovic	Interpolate GPS positions to the 10 second time
JUMPS	P. Petkovic	Seek and eliminate jumps from a data channel

LONGFIX	R. Parums	Fixes time-based file where 2*pi added to the longitude data
MASK	P. Petkovic	Delete data in a specified area
MATHS	D. Collins	Arithmetic operations on data values
MATTHEWS	C. Wilcox	Matthews correction to echo sounder depths (over Zone 64)
MNEG	P. Petkovic	Set x to -|x| for a whole channel
MRGPOINT	P. Petkovic	Compute mergepoint for 2 seismic lines (for Windows)
MRGPOINT	R. Parums	Compute merge points for file of seismic line pairs (VAX)
MSTATS	P. Petkovic	Statistical analysis of CRUX output
NAV2NRP	R. Parums	Translate navigation from the antenna position to the NRP
PATH	P. Petkovic	Compute distance between two points
PCEDAT	D. Collins	Edit files interactively (for Windows)
PICK	P. Petkovic	Pick start/stop files or SALVG control file (for Windows)
PLTCH	D. Collins	Plot data
QCDATA	P. Petkovic	Extracts compass & related data from 700-channel QC file
RESAM	D. Collins	Subsample files
RFIELD	P. Petkovic	Replace utility for tabular data
SALVG	H. Stagg	Correct data using values from analogue records
SCAT	P. Petkovic	Compute amount of scatter about a straight line
SMTH	D. Collins	Smoothing filter
SNUM	P. Petkovic	Change survey number
SPNX	P. Petkovic	Extract and correct ffid and time of ffid
STFIL	P. Petkovic	Fill gaps in shot-times file
STI	R. Tracey	Compute running mean speed for a 1 minute file
SUMS	P. Petkovic	+,-,*,/,^ a number to a channel of numbers
SWAP	D. Collins	Swap and copy channels
TRIM	P. Petkovic	Delete unwanted data
TSHIFT	P. Petkovic	Apply time shift to data file based on speed and distance
TURNS	R. Parums	Computes the straight line segments in a ship's track
TWINS	P. Petkovic	Compares up to 10 channels from 2 data files
WDOUT	P. Petkovic	Assigns positions to a time-value ASCII file
XTIME	P. Petkovic	Ignore records in a binary file which have bad times

Streamer Processing - Compass location file, Shot/receiver UKOOA

ADJUST	R. Parums	Adjusts streamer compass locns and matches to t/buoy locn
ANT2SRC	R. Parums	Substitute lat/long string from a UKOOA file to another
CABLE	P. Petkovic	Converts dx/dy values of streamer into lat/long coordinates
CHKREC	R. Parums	Checks the inter-receiver, inter-shot distances in shot/rec file
COMPASS	N. Johnston	Determine streamer offsets using streamer compass data
FILT_REC	R. Parums	Outputs good inter-compass dist records in compassUK file
GENRATE	R. Parums	Create file of shot/receiver locations from compassUK file
STRUKO	R. Parums	Convert all data in compassUK file from WGS84 to AGD84

Gridding and Mapping

CTIM	P. Petkovic	Create a control file of time-based files for PSMAP
GRID	M. Webring	Produces smooth grid
HELAVA	P. Petkovic	Reformat x,y,z grid file to x,y,z Helava format - ER Mapper

POLYMAKE	M. Sexton	Construct polygons from digitised line segments for Petrosys
PSMAP	various	Plot time-based or shot-based maps via Petroseis
REVERSE	M. Sexton	Prepares data for POLYMAKE
STIM	R. Parums	Create a control file of shot-based files for PSMAP
SUMMARY	M. Sexton	Summarises Petroseis culture dump file for PSMAP
VIEWGRID	P. Petkovic	View file produced by GRID (for Windows)
XYZTRIM	P. Petkovic	Delete null values and reformat ER-MAPPER grid file
ZYCOR	P. Petkovic	Extract x,y,z values from ZYCOR neutral grid

UKOOA File Checking

CHUKW	P. Petkovic	Check a UKOOA file for continuity (for Windows)
DSPN	P. Petkovic	Cumulative distance along a seismic line in UKOOA file
DUKO	P. Petkovic	Distance between UKOOA files
FIDSPN	P. Petkovic	Defines a relationship between ffid and spn based on time
ISECT	R. Parums	Compute seismic line intersections from UKOOA file
SHOTDIST	R. Parums	Reports duplicate SPs, jumps and large inter-shot distances
UKCHECK	R. Parums	Check file for shotpoint continuity, time/distance threshold
UKGAPS	R. Parums	Lists SP ranges of gaps in the geophys data in a UKOA file
UKLABS	R. Tracey	List line labels & geophysical data ranges in a UKOOA file
UKMAP	P. Petkovic	Map view of UKOOA file (for Windows)

UKOOA File Processing

CDP2SPN	R. Parums	Converts CDPs to SPs for UKOOA file, edit program to suit
HPUTWD	R. Parums	Outputs a DISCO wdepth 'HEADPUT' file from UKOOA file
MATTHEWS	R. Parums	Computes matthews corrected wdepths on UKOOA file
P12UK	R. Parums	Reformats P1/90 file to AGSO UKOOA format
P190	R. Parums	Reformats AGSO UKOOA file to P1/90 format
PSTRIP	R. Parums	Condenses a concatenated P1/90 file
RESEQ	R. Parums	Resequences and merges lineparts from a UKOOA file
SP_INTERP	R. Parums	Interpolate navigation and SP numbering across SP gaps
SPNUM	P. Petkovic	Resequence and rename lines in UKOOA file
UK2SSP	R. Parums	Translate navigation (at ship) to the SSP in a UKOOA file
UKOPART	P. Petkovic	Extract some lines from a UKOOA file
UKOSAM	P. Petkovic	Sub-sample UKOOA file
UKOUT	R. Tracey/D. Collins	Create UKOOA from time file by interpolating position at spn
WDCHK	R. Parums	Omits records with missing depth data (for Petroseis input)
ZEROFILL	R. Parums	Substitutes blanks in lat/long strings for zeroes

Miscellaneous Routines (in [NSP$SOFT.MSC]msc.olb)

AGRF	H. Stagg	Values of earth's magnetic field
BASENAME	R. Parums	Extracts the basename from a full file pathname
BEAR	P. Petkovic	Bearing from one point to another
BEEP	B. Goleby	Send beep

CGRF	R. Whitworth	As with AGRF, using Schmidt normalised coefficients
GEOC	P. Petkovic	Convert from geodetic to geocentric coordinates
GREAT	R. Whitworth	Distance along a great circle
GRFI	P. Hill	As with AGRF, using coefficients of IGRF
GROUP		Averaged median values of a set of points
INTERACT	D. Collins	Determine if a program is being run interactively
LOXO	P. Petkovic	Distance along loxodrome
LSFIT	P. Petkovic	Least squares fit of a line to a set of values
MOMENT	W. Press et al	Returns mean,avdev,sdev,var,skew and kurt from a data array
MERGESORT	P. Petkovic	Combines 2 sorted lists of integers into 1 sorted list
MSORT2D	P. Petkovic	Mergesort for 2D arrays
QSORT		Binomial sort routine
RHUMB		Distance along loxodrome (approximate)
STD	P. Petkovic	Standard deviation of data about a line
XSDF	P. Petkovic	Extract survey definition file data from *SURVDEF.ASC*
XSLF	R. Parums	Extract seismic line definition data (eg. *SURVUKO.ASC*)
XSEC	P. Petkovic	Return running seconds from *PROCLIM.ASC*
XUCF	R. Parums	Extract UKOOA control file data from *UKOOA.ASC*
XTIME	P. Petkovic	Return survey time form *PROCLIM.ASC*

Redundant Software

ASCDAT	D. Collins	Conversion ASCII -> binary unformatted
ATMIN	P. Petkovic	Interpolate lat/long to the whole minute
CALC	P. Petkovic	Simple calculator
DATASC	D. Collins	Conversion binary formatted -> ASCII
DELTA	H. Stagg	Compute rate of change (differences) in lat and long
DELZ	P. Petkovic	Deletes zeroes in a range of channels
DPREC	D. Collins	Test speed of double precision computation
FINDX	P. Petkovic	Find the intersection point between two lists of positions
GCOUT	P. Petkovic	Create ASCII file of geochem data at the shot position
GRISO	H. Miller	Convert gravity datum using 'long' formula
HPVAX	P. Petkovic	Conversion HP floating point -> VAX floating point format
INTEG	H. Stagg	Integrate rate of change of latitude and longitude
MAV	P. Petkovic	Moving average filter; allows ramping
MGDWD	P. Petkovic	Creates ASCII file of water depths from MGD77 file
NOFFS	R.Parums	Takes SPEED output and creates file for input into SPNDT
QDR	P. Petkovic	Simple dead reckoning program
SORT	P. Petkovic	Test of mergesort routine
SPEED	R. Parums	Makes file of avg speed changes from a given speed channel
SPNDT	P. Petkovic	Correction for offset to CMP
SPNFIX	P. Petkovic	Fix specific problem in shot-times file
SPREC	D. Collins	Test speed of single precision computation
UNMOD	P. Petkovic	'Unwrap' compass data (done by MATHS)
XTRACT	P. Petkovic	Extract files from concatenated ASCII files

Appendix 2 - Format of Special Files

ASCII Final Data Files

The format for ASCII files generated from binary unformatted files will have header records and data records.

The header records will describe the format of the data records and give other information relating to the survey. Each header record is to have keyword as the first word, followed by a colon. If the record overflows 80 characters, it is to continue to the next line indented by one space. The first and last header records will have '#' in column 1. For example,

```
#NAME: AGSO SURVEY 98R, VULCAN GRABEN 2 (SEISMIC REPROCESSING)
AREA: TIMOR SEA
ACQUISITION DATE: NOV/DEC 1990
CREATION DATE: 04-JUN-93
FILE:  S098RPD.ASC
CONTENTS:  STATION POSITION, DEPTH, GRAVITY FIELD, MAGNETIC FIELD
NAVIGATION : TRANSIT SATELLITE WITH DEAD RECKONONG AND DIFFERENTIAL
 GPS
POSITION DATUM: WGS84
GRAVITY DATUM: ISOGAL84
GENERIC FORMAT: (F7.3,F7.6,10X,2(I3,I2,F4.1,A1),I8,8X,I5,9X,I6)
        SURVEY NUMBER, JULIAN DAY NUMBER, GMT TIME (sss.ddd.hhmmss)
        LATITUDE DEGREES
        LATITUDE MINUTES
        LATITUDE DECIMAL SECONDS
        N/S HEMISPHERE FLAG
        LONGITUDE DEGREES
        LONGITUDE MINUTES
        LONGITUDE SECONDS
        E/W HEMISPHERE FLAG
        GRAVITY FIELD IN MICROMETERS/SEC/SEC
        WATER DEPTH (METRE)
        TOTAL MAGNETIC FIELD (NTESLA)
BLANKS: GIVEN AS 9'S TO FILL THE FIELD
FILE LIMITS: 10.7859S, 13.1084S, 123.4208E, 126.5332E
GRAVITY DATA: GRAVITY FIELD MEASURED USING BODENSEEWERK KSS31
  MARINE GRAVITY METER. 10 SEC DATA WAS DESPIKED, SUB-SAMPLED TO 1
  MINUTE VALUES, CORRECTED FOR EOTVOS EFFECT, THEN SMOOTHED WITH A 15
  MIN PERIOD SINC FUNCTION FILTER.
WATER DEPTH DATA: DIGITAL VALUES DERIVED FROM RAYTHEON 3.5 KHZ AND 12
  KHZ ECHO SOUNDERS. BAD DIGITALLY RECORDED VALUES WERE CORRECTED
  USING VALUES DERIVED FROM ANALOGUE CHARTS.
MAGNETIC DATA:
ADDITIONAL NOTES: THIS IS AN INTERIM FILE.
#
```

ASCTAPE

This term is used for the format of the shot-time file which is input into UKOUT. The file is obtained from seismic processing.

DAS

This term is used for the format of the shot-times file which is input into UKOUT and DELAY. The format is:

Column	1 - 10	Line name (left justified)	A10
	11 - 16	Shot point number	I6
	18 - 20	Julian day	I3
	22 - 27	UTC (hhmmss)	3I2

MGD77

MGD77 is an international ASCII format used for the storage of geophysical data. Brief details of the data format follow (For a full description of the data and header format specifications see file MGD77.TXT on the "GEODAS SETUP" CD-ROM).

Column	1 - 1	Data record type	I1
	2 - 9	Cruise identifier	A8
	10 - 14	Time-zone correction	F5.2
	15 - 16	Year (last two digits only)	I2
	17 - 18	Month number (ie. 01 - 12)	I2
	19 - 20	Day of month	I2
	21 - 22	Hour of day	I2
	23 - 27	Minutes	F5.3
	28 - 35	Latitude (dec degrees)	F8.5
	36 - 44	Longitude (dec degrees)	F9.5
	45 - 45	Position type code	I1
	46 - 51	Bathymetry 2-way traveltime (secs)	F6.4
	52 - 57	Bathymetry corrected depth (m)	F6.1
	58 - 59	Bathymetric correction code	I2
	60 - 60	Bathymetric type code	I1
	61 - 66	Magnetics total field, sensor 1 (nT)	F6.1
	67 - 72	Magnetics total field, sensor 2 (nT)	F6.1
	73 - 78	Magnetics residual field (nT)	F6.1
	79 - 79	Sensor for residual field	I1
	80 - 84	Magnetics diurnal correction (nT)	F5.1
	85 - 90	Depth/altitude of magnetic sensor	F6.0
	91 - 97	Observed gravity (mgal)	F7.1
	98 -103	Eotvos correction (mgal)	F6.1
	104 -108	Free-air anomaly (mgal)	F5.1

109 -113	Seismic line number	A5
114 -119	Seismic shot-point number	A6
120 -120	Quality code for navigation	I1

PROCESSING LIMITS & SEISMIC LINE LIMITS FILE

PROCLIM.ASC and *SEISLIN.ASC* are both control files. *PROCLIM.ASC* may be used as input to program GDAT and contains the start and stop times of the intervals over which navigation and geophysical parameters have been processed. *SEISLIN.ASC* may be used as input into programs PUKOUT, GDAT and contains the start and stop times for each seismic line.

Column	1 - 10	Line name	A10
	11 - 25	Start time (ssss ddd hhmmss)	I4, X, I3, X, I6
	27 - 41	Stop time (ssss ddd hhmmss)	I4, X, I3, X, I6

For 3 digit survey numbers, column 4 must be '/'. For 4 digit survey numbers, the survey number must be in columns 1 to 4.

SHIP

This is the format of the shot-times file as it comes off the ship.

Column	2 - 11	Line name	A10
	12 - 17	Shot point number	I6
	19 - 21	day number	I3
	23 - 28	UTC (hhmmss)	3I2
	29 - 30	UTC hundreths of seconds	I2

SURVEY DEFINTION FILE

[.TI]SURVDEF.ASC

SURVDEF.ASC is a control file for GDAT.

Column	1 - 10	File name	A10
	2 - 4	Survey number	A3
	11 - 13	Survey class (CMP, CMS etc)	A3
	14 - 15	Year of survey	I2
	16	Flag 'X' or 'U' to indicate file location	A1
	17 - 22	Northern latitude boundary (ddd mm)	I3, X, I2
	24 - 29	Southern latitude boundary (ddd mm)	I3, X, I2
	31 - 36	Western longitude boundary (ddd mm)	I3, X, I2
	38 - 43	Eastern longitude boundary (ddd mm)	I3, X, I2
	44	Navigation System code	A1
	45 - 46	Position reference/spheroid	A2
	48 - 49	Gravity datum (65 or 84)	I2
	50	Flag 'A', 'C', 'H' for navigation positioning	A1
	51	Flag 'D', 'W', 'S' or 'U' to indicate depth exists	A1
	52	Flag 'G' to indicate gravity exists	A1
	53	Flag 'M' or 'Z' to indicate magnetics exists	A1
	54	Flag 'S', 'N' or 'D' seismic indicator	A1
	55	Fag 'T', 'L' or 'S' time index indicator	A1
	57 - 74	Survey name or NGDC index	A18
	76 - 92	Platform	A17
	94 - 103	Institution	A10
	104 - 111	Date at which data last changed	A8
	113 - 113	Creation/Modification type	A1

Notes:

11:13 The survey classifications are as follows:

CMS	AGSO Continental Margins Survey (1970-1972)
CMP	AGSO Continental Margins Program (After Survey 46, 1985-)
OTM	AGSO Ocean Territories Mapping Program (after Survey 176)
CON	Other AGSO related surveys
FOR	All foreign surveys
TRI	Tripartite surveys
NGD	Derived from NGDC database on CD-ROM

16:16 The file location flag is used if there is no file in the current directory. The flag 'X' indicates that no digital data file exists for this survey, while the 'U' indicates that a shotpoint location (*.ASC or *.UKO) file exists in the [.UK] directory.

Latitudes are negative in the southern hemisphere.

44:44 The navigation system code is:

A - differential GPS system
B - dead reckoning tied to Transit satellite fixes plus differential GPS
C - dead reckoning tied to Transit satfixes plus stand-alone GPS system
D - radio navigation
E - dead reckoning tied to Transit satellite fixes
F - stand-alone GPS (subject to selective availability)

45:46 The position reference codes are as follows:

Code	System	Semi-major Axis	Inverse of Flattening
AP	APL72		
A6	AGD66	6378160.0	1/298.25
A4	AGD84	6378160.0	1/298.25
72	WGS72	6378135.0	1/298.26
84	WGS84	6378137.0	1/298.25722
AN	ANS	6378160.0	1/298.25
CL	Clarke	6378350.9	1/294.26

48:49 The gravity datum is given as 65 (Isogal65) for the Potsdam datum and 1930 international gravity formula. The datum is given as 84 (Isogal84) for the IGNS71 system and the 1967 international formula.

50:50 Indicates whether the navigation position in the file refers to the antenna position 'A' or the navigation reference point (NRP) at the monkey island 'M' or at the stern of the ship 'S'.

51:51 The depth flag 'D' indicates the data were corrected to the water line with the known distance of transducer to water line and a speed of sound of 1500m/s. The depth flag 'W' indicates that the data were corrected with a nominal distance of 4m from transducer to water line and a speed of sound of 1500m/s. The 'S' flag indicates that a "slow" speed of sound (of 1463m/s) was used and corrected to the waterline . This figure is an exact multiple of a fathom and is commonly used on American ships. The 'U' flag indicates an unknown speed of sound.

53:53 The 'M' indicates that the file contains mag data, but which may not have been corrected for sensor offset. The 'Z' indicates that the mag data have been corrected for sensor offset, so that the magnetic total field values are given at their true positions.

54:54 The survey indicator signifies:

N - seismic data is not available for this survey
S - regional seismic coverage is available (majority of AGSO seismic surveys)
D - detailed seismic coverage is available, eg prospect level surveys

55:55 Index indicator 'T' indicates that the file is indexed by GMT time, while 'L' indicates that the index is local time. Where this happens, channel 10 holds the time zone correction and should be added to the time to give GMT. This has only been checked for some foreign surveys (1301 - 1332), so beware! Index indicator 'S' signifies that the file is indexed by line number and shot point number, with the line number in the day field and the shot number in the time field.

104:111 The date of creation is the character string of the form dd-mm-yy, where dd is the data, mm the numerical month and yy the abbreviated year. This field should only be altered when any data in the file are changed.

113:113 The creation/modification type has the following classifications:

C - Creation of the file
M - Modification of existing data in the file
A - Addition of extra data to the file
U - Unknown

UKOOA CONTROL FILE

NSP$DISK:[NSP3.UK]UKOOA.ASC

UKOOA.ASC is read by program STIM, VERSION and UKOINFO.

Column	1 - 10	File name	A10
	2 - 4	Survey number	A3
	11 - 13	Survey class (CMP, CMS etc)	A3
	14 - 15	Year of survey	I2
	17 - 22	Northern latitude boundary (ddd mm)	I3, X, I2
	24 - 29	Southern latitude boundary (ddd mm)	I3, X, I2
	31 - 36	Western longitude boundary (ddd mm)	I3, X, I2
	38 - 43	Eastern longitude boundary (ddd mm)	I3, X, I2
	45 - 62	Survey name	A18
	64 - 81	Survey platform (ship)	A18
	82 - 91	Institution	A10
	92 - 99	Version Date (dd-mm-yy)	A8
	101 - 101	File Creation Flag	A1

UKOOA

The AGSO UKOOA **high precision format** (files generated by UKOUT) has been in use from survey 127 (Enderby Terrace survey for NOPEC) onwards and is defined as:

Column	1 - 16	Line name (left justified)	A16
	17 - 23	Shot point number	I7
	24 - 33	Latitude (deg, min, sec, N/S)	I2, I2, F5.2, A1
	34 - 44	Longitude (deg, min, sec, N/S)	I3, I2, F5.2, A1
	45 - 52	Gravity ($\mu m/s^2$)	I8
	61 - 65	Depth (neg)	I5
	66 - 75	Julian day (ddd) and UTC (hhmmss)	I3, 3I2, I1
	76 - 80	Magnetic Field (nTesla)	I5

The AGSO UKOOA **normal precision** format, used before survey 127 is:

Column	1 - 16	Line name (left justified)	A16
	17 - 23	Shot point number	I7
	26 - 34	Latitude (deg, min, sec, N/S)	I2, I2, F4.1, A1
	35 - 44	Longitude (deg, min, sec, N/S)	I3, I2, F4.1, A1
	45 - 52	Gravity ($\mu m/s^2$)	I8
	61 - 65	Depth (neg)	I5
	66 - 75	Julian day (ddd) and UTC (hhmmss)	I3, 3I2
	75 - 80	Magnetic Field (nTesla)	I6

The **UKOOA P1/90** post-processed navigation file standard is as follows and should be provided to external clients when requested (See the UKOOA "P1/90 Post Plot Data Exchange Tape 1990 Format" manual for further details on header definitions etc).

Column	1 - 1	Record Identification	A1
	2 - 13	Line name (left justified)	A12
	14 - 16	Spare	3X
	17 - 17	Vessel ID	A1
	18 - 18	Source ID	A1
	19 - 19	Tailbuoy/other ID	A1
	20 - 25	Shot point number	I6
	26 - 35	Latitude (deg, min, sec, N/S)	I2, I2, F5.2, A1
	36 - 46	Longitude (deg, min, sec, N/S)	I3, I2, F5.2, A1
	47 - 55	Map Grid Easting (m)	F9.1
	56 - 64	Map Grid Northing (m)	F9.1
	65 - 70	Water Depth	I5
	71 - 73	Julian day	I3
	74 - 79	Time (hms)	3I2
	80 - 80	Spare	1X

TIME-BASED ASCII

A format, which is used to set up time-based data for import into Petroseis (used for seismic surveys which were shot with real line names), is referred to as Pseudo-UKOOA (from program PUKOUT) and is defined as follows:

Column	1 - 12	Line name (left justified)	A12
	14 - 16	Day number[6]	I3
	17 - 23	Time (.hhmmss)	F7.6
	24 - 30	Pseudo-shot point number (running mins[7])	I7
	31 - 39	Latitude (deg, min, sec, N/S)	I2, I2, F4.1, A1
	40 - 49	Longitude (deg, min, sec, N/S)	I3, I2, F4.1, A1
	51 - 56	Depth (neg m)	I6
	57 - 64	Gravity ($\mu m/s^2$)	I8
	65 - 69	Gravity Free-air anomaly ($\mu m/s^2$)	I5
	70 - 75	Magnetic Field (nTesla)	I6
	76 - 80	Magnetic IGRF anomaly (nTesla)	I5

This format is only valid where there are seismic lines (In fact, program PUKOUT will only output data where seismic lines exist).

An alternative time-based format, which is used for surveys where seismic data were not acquired (eg. AGSO geology cruises or track data from foreign institutions), is referred to as UKODAY format (either from program UKODAY or MAKEDB) and is defined as follows:

Column	1 - 8	Line name	(AGSO ID/Day)	A8
	9 - 15	Time	(.HHMMSS)	F7.6
	17 - 20	Time, Pseudo-SP number	(decimal hours *100)	I4
	22 - 30	Latitude	(DMS)	A9
	31 - 40	Longitude	(DMS)	A10
	43 - 47	Water Depth	(M)	I5
	49 - 55	Total Gravity Field	(Microm/s/s)	I7
	57 - 61	Free Air Anomaly	(Microm/s/s)	I5
	63 - 68	Total Magnetic Intensity	(nTesla)	I6
	70 - 74	IGRF anomaly	(nTesla)	I5
	76 - 80	Bouguer anomaly	(Microm/s/s)	I5

This output format creates both a pseudo-shot and -linename and is used when displaying the entire ship's track. The track data are split into fictitious linenames (comprising of the survey number and day) at the start of each new day.

[6] Normally the Julian day, but sometimes the number of days into the survey (eg as with AGSO CMS surveys), depending upon the day numbering convention used during acquisition of the survey.
[7] This figure is obtained by converting the day number and time into running minutes from the start of year or survey. It is determined by the formula (day number -1)*1440 + hh*60 + mm. It is needed for software packages which accept the data in shot-based format, such as Petroseis.

Appendix 3 - Required Contents of Processing Notes

The processing notes will give a complete and detailed documentation of the processing of a survey and should be put together in such a way as to allow your project to be passed to another person. It should contain the following:

Summary

A standard tabular listing of the history of the process. A blank is on the next page. This is to be maintained in ink so that no erasures can be made.

Commentary

A free-form diary documenting the history of the process. It should contain the date of commencement of each process or program, notes on file names, their start and stop times, parameters used for preparing maps, and other notes as required. In the interests of legibility and interaction between processors, this diary is to be maintained using Word for Windows and should be named SnnnPROC.DOC in a directory of your choice on your PC. At the end of the project it should be copied to FREND$DKB700:[NSP1.MISC] and a hard copy to go in the Processing Notes folder.

Start/Stop Listing

Table of start/stop times of seismic lines any other significant information about relevant intervals. These tables should be part of SnnnPROC.DOC.

Channel Allocation Listings

Table of non-seismic acquisition channels (usually a photocopy of the relevant appendix of the systems report).

Table of processing channel allocation. A table should exist for each of the standard files SnnnFXN.DAT, SnnnFXG.DAT and any time the channel allocation is changed. These tables should be part of SnnnPROC.DOC.

Hard copy of parameter files and miscellaneous items

To avoid loss of vital control and parameter setting files, they should be backed up by listing:

Survey: **Page** **of**

Processor:

Process	Comments	File in	File out	Aux. File	Date

Appendix 4 - Acquisition Channel Allocation

The following is a list of channel allocations for the non-seismic data.

Data are acquired at 1 second sample rate. The main data set is saved on magnetic tape every minute in blocks of 100 x 60 x 4 (24000) bytes. This represents 100 data words (channels) blocked every minute with 4 bytes per word.

1	Survey and day number from DAS computer clock	(sss.ddd)
2	Acquisition GMT from DAS computer clock	(hhmmss)
3	GPS - VMS clock difference	(secs)
4	Latitude, best estimate	(radians)
5	Longitude, best estimate	(radians)
6	Speed, best estimate	(knots)
7	Course, best estimate	(degrees)
8	magnetometer#1	(nTesla)
9	magnetometer#2	(nTesla)
10	Depth from 12 kHz echo sounder	(metres)
11	Depth from 3.5kHz echo sounder	(metres)
12	F/A Magnavox sonar Doppler	(3920 counts/nm)
13	P/S Magnavox sonar Doppler	(3920 counts/nm)
14	F/A Raytheon sonar Doppler	(200 cts/min)
15	P/S Raytheon sonar Doppler	(200 cts/min)
16	Paddle log wheel	
17	NOT USED	
18	Instrument room Sperry gyro heading (synchro)	(degrees)
19	Bridge Sperry gyro heading	(degrees)
20	NOT USED	
21	MX100 time	(hhmmss)
22	MX100 latitude	(radians)
23	MX100 longitude	(radians)
24	MX100 height above geoid	(metres)
25	MX100 speed	(knots)
26	MX100 course (degrees)	
27	MX100 number of satellites	
28	MX100 uncertainty	
29	MX100 spare	
30	MX100 spare	
31	Racal dGPS #1 UTC time of record	(hhmmss)
32	Racal dGPS #1 UTC time of record - time of fix	(ss.s)
33	Racal dGPS #1 latitude	(radians)
34	Racal dGPS #1 longitude	(radians)
35	Racal dGPS #1 height	(metres)
36	Racal dGPS #1 speed	(knots)
37	Racal dGPS #1 course	(degrees)
38	Racal dGPS #1 number of satellites	

39	Racal dGPS #1 PDOP	
40	Racal dGPS #1 HDOP	
41	Racal dGPS #1 3-D position error	(metres)
42	Racal dGPS #1 2-D position error	(metres)
43	Racal dGPS #1 differential quality (0=no corr, 1=bad, 9=good)	
44	Racal dGPS #1 flag	(see below)
45	Racal dGPS #1 time since last correction	(mmss)
46	Best latitude raw	(radians)
47	Best longitude raw	(radians)
48	Std deviations of raw latitude	(radians)
49	Std deviations of raw longitude	(radians)
50	NOT USED	
51	Racal dGPS #2 UTC time of record	(hhmmss)
52	Racal dGPS #2 UTC time of record - time of fix	(ss.s)
53	Racal dGPS #2 latitude	(rads)
54	Racal dGPS #2 longitude	(rads)
55	Racal dGPS #2 height	(metres)
56	Racal dGPS #2 speed	(knots)
57	Racal dGPS #2 course	(degrees)
58	Racal dGPS #2 number of satellites	
59	Racal dGPS #2 PDOP	
60	Racal dGPS #2 HDOP	
61	Racal dGPS #2 3-D position error	(metres)
62	Racal dGPS #2 2-D position error	(metres)
63	Racal dGPS #2 differential quality (0=no corr, 1=bad, 9=good)	
64	Racal dGPS #2 flag	(see below)
65	Racal dGPS #2 time since last correction	(mmss)
66	NOT USED	
67	NOT USED	
68	Cross-course error	(nautical miles)
69	Start-of-line (SOL	(nautical miles)
70	End-of-line (EOL)	(nautical miles)
71	Latitude Sonar Doppler 1	(radians)
72	Longitude Sonar Doppler 1	(radians)
73	Speed	(knots)
74	Heading	(degrees)
75	Latitude Sonar Doppler 2	(radians)
76	Longitude Sonar Doppler 2	(radians)
77	Speed	(knots)
78	Heading	(degrees)
79	Latitude Paddle log	(radians)
80	Longitude	(radians)
81	Speed	(knots)
82	Heading	(degrees)
83	Nav type	(see below)
84	Gravity	(mGal)
85	ACX	(μmetres/s^2)
86	ACY	(μmetres/s^2)
87	Sea state	
88	NOT USED	

89	Magnetometer	(nTesla)
90	NOT USED	
91	Tail buoy time	(.hhmmss)
92	Tail buoy latitude	(radians)
93	Tail buoy longitude	(radians)
94	Tail buoy altitude	(metres)
95	Tail buoy number of satellites	
96	Tail buoy uncertainty	
97	Tail buoy diff latitude	(radians)
98	Tail buoy diff longitude	(radians)
99	Tail buoy feather angle	(degrees)
100	Tail buoy distance	(nautical miles)

Racal dGPS "flag" is a 5 digit number n1, n2, n3, n4, n5 as follows;

n1:	Operating Mode	0 = no solution
		1 = 4 space vehicles (SV)
		2 = 3 SV + altitude aiding
		3 = 3 SV + clock aiding
		4 = 2 SV + altitude aiding + clock aiding
		5 = all in view
n2:	Receiver Code	7 = C/A, L1 only, carrier aided
n3:	Receiver Dynamics	0 = static, 1...9 represents low...high
n4:	Position Quality	0...9 represents bad...good
n5:	Differential Quality	0 = no corrections, 1....9 represents bad...good

Nav Type codes are as follows:

1	Racal #1 differential
2	Racal #2 differential
3	Racal #1 non-differential
4	Racal #2 non-differential
5	Dead Reckoning
6	MX100 GPS
7	Radio Navigation

The following is a list of past channel allocations for the non-seismic data.

The main data set was saved on magnetic tape every minute in blocks of 128 x 6 floating point words. This represents 128 data channels of 6 records per block.

1	Survey and day number from DAS computer clock	(sss.ddd)
2	Acquisition GMT from DAS computer clock	(hhmmss)
3	GPS - VMS clock difference	(secs)
4	Latitude, best estimate	(radians)
5	Longitude, best estimate	(radians)
6	Speed, best estimate	(knots)
7	Course, best estimate	(degrees)
8	magnetometer #1	(nTesla)
9	magnetometer #2	(nTesla)
10	Depth from 12 kHz echo sounder	(metres)
11	Depth from 3.5kHz echo sounder	(metres)
12	F/A Magnavox sonar Doppler	(3920 counts/nm)
13	P/S Magnavox sonar Doppler	(3920 counts/nm)
14	F/A Raytheon sonar Doppler	(200 counts/min)
15	P/S Raytheon sonar Doppler	(200 counts/min)
16	Paddle log wheel	
17	NOT USED	
18	Instrument room Sperry gyro heading (synchro)	(degrees)
19	Bridge Sperry gyro heading	(degrees)
20	NOT USED	
21	MX100 time	(hhmmss)
22	MX100 latitude	(radians)
23	MX100 longitude	(radians)
24	MX100 height above geoid	(metres)
31	Racal dGPS #2 UTC time of record	(hhmmss)
32	Racal dGPS #2 latitude	(radians)
33	Racal dGPS #2 longitude	(radians)
34	Racal dGPS #2 height	(metres)
35	Racal dGPS #2 course	(degrees)
36	Racal dGPS #2 speed	(knots)
37	Racal dGPS #2 number of satellites	
38	Racal dGPS #2 PDOP	
39	Racal dGPS #2 HDOP	
34	Racal dGPS #2 3-D position error	(metres)
35	Racal dGPS #2 2-D position error	(metres)
36	Racal dGPS #2 differential quality (0=no corr, 1=bad, 9=good)	(see above)
37	Racal dGPS #2 flag	(see above)
39-50	(Formerly T-Set GPS)	
51	Latitude from Dead Reckoning System 1	(radians)
52	Longitude from Dead Reckoning System 1	(radians)
53	Speed from Dead Reckoning System 1	(knots)
54	Course from Dead Reckoning System 1	(degrees)
55	Latitude from Dead Reckoning System 2	(radians)
56	Longitude from Dead Reckoning System 2	(radians)

57	Speed from Dead Reckoning System 2	(knots)
58	Course from Dead Reckoning System 2	(degrees)
59	Latitude from Dead Reckoning System 3	(radians)
60	Longitude from Dead Reckoning System 3	(radians)
61	Speed from Dead Reckoning System 3	(knots)
62	Course from Dead Reckoning System 3	(degrees)
67	GMT from Magnavox MX1107	(seconds)
68	Dead reckoned time from MX1107	(seconds)
69	MX1107 latitude	(radians)
70	MX1107 longitude	(radians)
71	MX1107 speed	(knots)
72	MX1107 heading	(degrees)
73	GMT from Magnavox MX1142	(seconds)
74	Dead reckoned time from MX1142	(seconds)
75	MX1142 latitude	(radians)
76	MX1142 longitude	(radians)
77	MX1142 speed	(knots)
78	MX1142 heading	(degrees)
79	Gravity	(mGal)
80	ACX	(μmetres/s^2)
81	ACY	(μmetres/s^2)
82	Sea state	
86	Shot time (hhmmss)	
87	Shot point number	
88	Northerly set/drift	(radians/10 secs)
89	Easterly set/drift	(radians/10 secs)
110	Racal dGPS #1 UTC time of record	(hhmmss)
111	Racal dGPS #1 latitude	(radians)
112	Racal dGPS #1 longitude	(radians)
113	Racal dGPS #1 height	(metres)
114	Racal dGPS #1 course	(degrees)
115	Racal dGPS #1 speed	(knots)
116	Racal dGPS #1 number of satellites	
117	Racal dGPS #1 PDOP	
118	Racal dGPS #1 HDOP	
119	Racal dGPS #1 3-D position error	(metres)
120	Racal dGPS #1 2-D position error	(metres)
121	Racal dGPS #1 differential quality (0=no corr, 1=bad, 9=good)	(see above)
122	Racal dGPS #1 flag	(see above)

The **Transit satellite fix information** from both the MX1107 and MX1142 was saved in blocks of 20 floating point words when the fix data became available. The data from each satnav are in similar format, each being identified by the first word.

1	1107 or 1142	
2	Day number (1107) or date (1142)	
3	GMT	
4	Latitude	(radians)
5	Longitude	(radians)
6	Used flag	(0 = not used, 1 = used)
7	Elevation	(degrees)
8	Iterations	
9	Doppler counts	
10	Distance from DR	(nautical miles)
11	Direction from DR	(degrees)
12	Satellite number	
13	Antenna height	(metres)
14	Doppler spread flags (1107 only)	
.	" " "	
.	" " "	
20	" " "	

Appendix 5 - Standards and Guidelines for Software Developments in AGS Marine Data Processing

Detailed guidelines for programming in the Non-Seismic Processing system are given in the booklet *Non-Seismic Processing Software Conversion* (28 Feb 1992) describing the contract to convert NoSDaP from the HP to the VAX. Programmers should refer to this and also browse through some of the code already written, to gain a feel for the general style of programming desired. Naturally, though, each programmer will reflect their own individuality to some degree.

Refer also to *Treatment of Data* above for guidelines on data types, etc.

Programming Language

FORTRAN 77 for programs in the VAX/VMS environment. QuickBasic or C++ for Windows in the PC/MS-DOS/MS_Windows environment.

The following specifications refer to FORTRAN code, although the general principles should apply irrespective of the language used.

Program Structure and Control Constructs

Structured programming principles apply, to the extent that software is easy to read, understand and debug. Programs should be written such that:

- procedures are modular and logically sequential (ie flow of control is from top to bottom),
- repetitive processes are blocked and nested logically (without going so deep as to be obscure),
- loops have single entry and exit points; there is no functionality that can't be achieved easily another way;
- use of GOTO statements is restricted to skip forward (eg in the case of error trapping in I/O).

Program Layout

In general, code should be written in a consistently neat and tidy manner to ensure legibility and to facilitate debugging and modification.

The general structure for a program will have:

- main module
- menu module
- work module
- supplementary work routines
- standard modules as part of libraries

Within each module, the following should apply:

Case: All lower case, or all lower case except FORTRAN reserved words.

Headers: Each procedure to begin with identifiable header records which give:

- the procedure name (begin with c***)
- author's name (c***)
- creation date (c***)
- purpose of the procedure (c**) and,
- explanation and type of main variables and all arguments required by the module (c*)

Comments: There is no limit to the number of comment lines within a procedure. The headers will be a block of comments as described above. A general comment should precede each distinct block of code, to include explanation of locally used variables. Supplementary comments should appear at the right hand end of any line of code as necessary.

Labels: Line labels should be used only where absolutely necessary. If used, they should run numerically from beginning to end and incremented by 10 or more to allow insertion of labelled code at a later date. If line labels are used, the first label in each block of code should be a new multiple of 100. If format statements can not be embedded in READ/WRITE commands, they should be labelled above 1000.

Loops: Statements with a loop or within each part of a conditional statement, should be indented by no less than 2 characters.

Organisation: Each routine should have one entry point at the beginning and exit at the end. The following order should be used in laying out the routine between entry and exit:

- documentation and comments,
- IMPLICIT NONE, then declaration and initialisation of variables,
- initialisation and file opening routines,
- body of program,
- error handling routines,
- exit routines

Separation: Distinct parts of a program should be separated by blank lines.

File Organisation

There should be 1 module per file. The module should perform a significant logical function. In the case of logically related modules, they may be written into a single file.

Constants

Numbers should be defined as parameters, so that a number is always represented symbolically.

Variables and Arrays

Initialisation: Variables and arrays must be initialised.

Subscripts: Array subscripts must be integer expressions

Common Blocks

Use of common blocks is to be avoided. Where possible, variables should be passed into subroutines rather than placing common into subroutines. Exceptions to this are when the called routine is deeply embedded in the program.

When used, only named common blocks are allowed.

Where used, common blocks must not mix character entities with other data types, as FORTRAN77 does not specify a relationship between numeric and character storage units.

At present, the only common blocks in the code are used within families of routines. For example, the IO routines access a common block called IO that stores information about the current position in the file. This common block is not to be accessed by any other routines.

Arguments

Data is to be passed by reference and strings by descriptor, except when calling VMS routines, many of which require pass by value. The use of common and global variables is to be avoided.

Order: Required arguments should precede optional arguments. The following order should be used:

- required input arguments,
- required input-output,
- required output,
- optional input arguments,
- optional input-output,
- optional output arguments

If the argument list has to be lengthened at a later date, the order of arguments should not be changed unless the calling statement is changed in every procedure that uses that list.

Input/Output

Input file names cannot be hard-coded. Log files may be, but should include the date in the filename.

All hard-coded directory names must be referred to using their logical names. This is standard practice in VMS. Any new logical names should be defined in:

APPL$SOFT:[NSP.DCL]NSP_ENVIR.COM.

File names and program control parameters should be specified in answer files wherever possible. It should be possible to specify answer files in the run string to take advantage of batch processing. For example:

$ RUN FINAV [*answer_file_name*]

Read/Write ASCII data into a character array and decode separately.

Read/Write binary data as single buffers and decode separately.

Avoid use of non-standard FORTRAN I/O.

Use formal parameters, not common blocks, for FORTRAN logical units.

Error Handling

All likely I/O errors must be trapped to prevent program crashes. The error message must point to the routine in which the error occurred and give an error code to indicate what the error was. Code for error messages should be located near the end of the procedure.

Names

Constants, Variables: To represent the quantity in a meaningful way.

Main Program: To represent the action of the program in a meaningful way, in 9 characters or less.

Procedures: To be named 'prefix_suffix' where:

'prefix' is the name of the calling program, or
up to 3 characters defining the library or procedure group,
'suffix' describes what the procedure does and may be in the form 'verb_noun'.

Typically, the suffix for the menu module is _MENU and the top level work routine is _WORK.

File: The same as the procedure name.

Documentation: The same as the name of the procedure described.

Extensions: The following extensions should be used:

.ANS	answer files
.ASC	ASCII data files
.DAT	binary data files
.DOC	documentation files
.FIN	include files
.FOR	FORTRAN source code
.HED	header files
.HIS	history files
.TXT	text files not related to program documentation
.UKO	UKOOA format ASCII files

Testing

Procedures to be tested before being integrated into a library.

User Interface

User interface should allow on-screen menu for setting of initialisation parameters and I/O file names.

The question and answer approach to setting initialisation parameters should be used only where necessary and where it is most efficient to do so.

Bibliography

Digital Equipment Corporation, 1988, "Guide to Creating VMS Modular procedures"

DISCO Programmer's Manual 7.3, June, 1988.

Software Standards and Programming Guidelines for Analysts and Programmers designing and Writing Technical Software in the Power & Water Authority (unpublished).

Appendix 6 - Copying between disk and tape

Disk to Tape

Output to tape from disk may be necessary when satisfying client requests. This may be done by using the following commands (MUC0: is a typical drive name):

- Logon to GARP2 and set default directory
- $ MOUNT/FOREIGN/BLOCK=*number_of_bytes* MUC0:
- $ COPY FILE1,......FILEn MUC0:
- $ DISMOUNT/NOUNLOAD MUC0:

ASCII and binary data may be written to either 3480, 9-track tape[8], exabyte or dat tapes. If multiple files have been copied, these will sequentially be written to tape separated by EOF markers. After copying, the files should be read back to confirm that the process has been successful.

This may be done by using the following commands.

- $ MOUNT/FOREIGN/BLOCK=*number_of_bytes* MUC0:
- $ COPY MUC0: TEST1
- $ COPY MUC0: TESTn

The copy command should be repeated once for each of the files.

- DISMOUNT MUC0:

Check output to see that data is as it should be. Delete TEST1,.....TESTn, if successful.

In order to copy disk files from the VMS environment, firstly convert the file to a fixed length (number_of_bytes), say 80 characters/record. The header lines, if any, should be padded with spaces to the specified length. (MKA0: in this case is an exabyte drive).

- $ MOUNT/FOREIGN/BLOCK=*number_of_bytes*/RECORD=*number_of_bytes* MKA0:
- $ COPY TEST1 MKA0:
- $ DISMOUNT MKA0:

[8] This media type is currently not supported by AGSO. However, should data need to be stored on this media, the data should be blocked using program BLOUT.

NOTE: The copying of large files to dat or exabyte tapes is a time-consuming process. The process of verification is even more time-consuming.

Tape to Disk

When restoring data from field tapes, simply use the VMS copy command, as in:

$ COPY *.* *file_name.dat*

However, the file attributes may be wrong. (Check this by doing a DIR/FULL on the file.) For example, VMS may pick up the file as a variable record file, when in fact it should have fixed length records. In order the convert the file to one of the correct record attributes, run the VMS FDL (file definition language) utility, as follows:

$ ANALYZE/RMS/FDL *file_name.dat*

This creates a file file_name.fdl

$ EDIT/FDL *filename.fdl*

This puts you in the FDL editor. In the FDL editor, use the Modify option, then select Record from the next menu.

Modify the attributes of the record to the following settings:

BLOCK_SPAN	YES
CARRIAGE_CONTROL	NONE
FORMAT	FIXED
SIZE	4 x number of channels

Note that the size refers to the number of bytes per record and there are 4 bytes per VMS word.

Exit (not Quit) from the FDL editor and this will create a new version of the file_name.fdl file. Then convert the data file to one of the correct attributes as follows:

$ CONVERT/FDL=*file_name.fdl* *file_name.dat* *new_file.dat*

Appendix 7 - Finding Merge Points

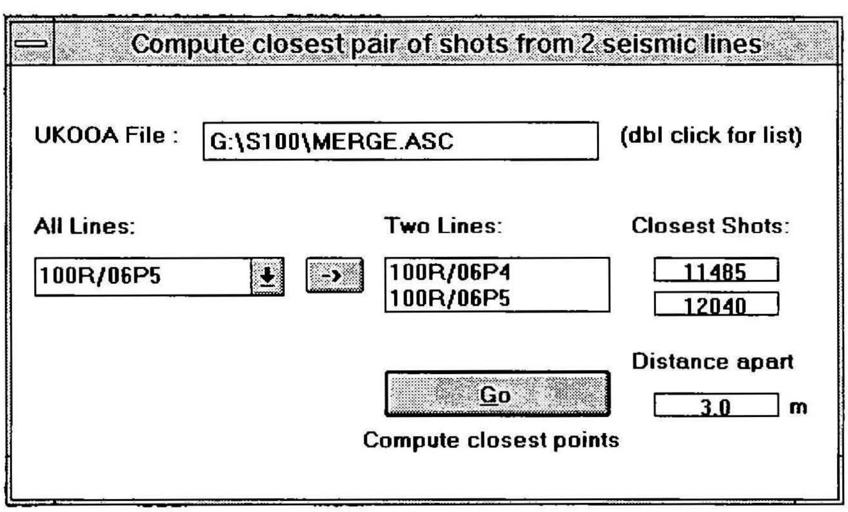
- Produce the final UKOOA format file (*.ASC) and resample to every 10^{th} shot (*.UKO).

- View the resampled file (*.UKO) with UKMAP to determine which parts of lines overlap.

- Using the editor, extract from *.ASC those sections where the lines overlap and place into a new file called MERGE.ASC. This file will therefore have every shot in those regions where the lines overlap. It is OK to use more data than is overlapping, but this will make the next step a little longer.

- Run program MRGPOINT from Windows on the PC to compute the nearest pair of points from each pair of line parts. MRGPOINT simply computes every single combination of distances for the two lines selected and returns the pair of shotpoints which give the minimum distance.

In the following example, MRGPOINT has computed that the minimum distance between lines 6p4 and 6p5 occurs between shotpoints 11485 and 12040 and is a distance of 3m.



In the resequencing of line 6, therefore, shot 11485 of line 6p4 should be followed by shot 12041 of line 6p5.

Associated Problems

If producing merge points for seismic data being reprocessed, the contractor will probably be using FFIDs as the shot point numbers. Therefore, it is not possible to use the existing UKOOA file in which the SPs may not have a direct relationship with FFIDs. To produce UKOOA data for the ffid-based processing, it is necessary to have a file of ffid times. If this cannot be obtained from our seismic database, it will have to be read from the navigation field tapes as described in the processing instructions, or, if that is not feasible, created from the shot-logger listings held at archives. The latter involves the following:

- Get the shot logger records for the required lines.

- Create a file of ffid and time, with a record for every time the operator's log shows that the ship's speed (and hence the shot interval) has changed. This file is used by the program REFE and has the following format:

```
line_name   ffid1,  ffid2,  day1,  time1,  day2,  time2
   a10,      i6,     i6,     i3,    i6,     i3,    i6
```

- Execute REFE which interpolates linearly between the two shotpoints and produces a ffid-time file in "ship" format. As the program executes, check that the shot interval column does not contain unrealistic numbers.

- From there on the process is as normal:

shot_time_file -> DELAY -> UKOUT -> compute merge points -> edit UKOOA file to merge points -> SPNUM

Appendix 8 - Common Client Requests

Extracting Time-based Digital Data

The time-based data reside in the directory nsp$disk:[nsp3.ti]. All data files are in VMS floating point format and, for external use, will generally have to be converted to an ASCII format. The file *SURVDEF.ASC* is a listing of the data in this directory and is a control file used by data extraction programs, such as GDAT. Documentation for each processed survey can be found in the file nsp$disk:[nsp1.misc]surveys.doc.

Requests for data most commonly define a geographical area and geophysical parameter, such as "all water depth and gravity data as free-air anomaly values in the area 10°S - 12°S and 110°E - 112°E". The program GDAT allows a user to extract data from the database, according to the most commonly used criteria, and is described in this manual. GDAT produces a VMS floating point file, giving the time index, the position of each data value and the data values.

Having extracted the data, a mistie analysis must be performed to check for any problems not previously corrected. CRUX finds the intersections and computes the misties and MSTATS computes summary statistics on the CRUX output file. The output from these two programs is checked by a supervisor, who may instruct corrections to be made to the data files, if necessary.

Converting Time-based Digital Data from Binary to ASCII Format

When the GDAT output file is considered ready, it must be converted to an ASCII format file for export. Programs TIMOUT and DATASC can be used to convert such a file containing data from multiple surveys. Programs TIMOUT, DATM77, UKODAY, PUKOUT, MAKEDB and DATASC can all be used to perform binary to ASCII conversions for individual survey files. The differences between these are in the way they convert the time index. For example, DATM77 creates an MGD77 format file containing a year/month/day/time index, while UKODAY uses a pseudo-shot index of decimal hours * 100, with the purpose of importing into Petroseis. MAKEDB is a similar program to UKODAY, except that it operates on database files only and may, by reading a file-list, convert any number of files in the database to create a mirror-image database in ASCII format.

MAKEDB and UKODAY are commonly used when supplying data to projects where the ship's track times are to be plotted using Petroseis. However, if the data is all that is required, TIMOUT should be used. It creates a separate header file which contains information about the data for each survey. Header records for the MGD77 format files must be carefully checked against the MGD77 format specification, as DATM77 makes certain assumptions about the data when setting up the header records.

PUKOUT is used when supplying data to projects where the ship's track times and acquired seismic line names are to be plotted using Petroseis. In contrast to UKODAY, it is used when the seismic survey information is sought.

Extracting Shotpoint-based Digital Data

The shot-based data reside in the directory nsp$disk:[nsp3.uk] as UKOOA format files. A control file for all surveys contained in the database can be found in the file, *UKOOA.ASC*, in the sam directory. Documentation pertaining to directory contents is in the Word format file nsp$disk:[nsp3.misc]surveys.doc.

Program UKOINFO creates a file containing information about each seismic line according to selected survey classifications. After the program has been run, the output file may be edited to suit if certain surveys are to be excluded from any further extraction procedure. Program XSEIS may then be used to take the output from UKOINFO and extract seismic UKOOA records that lie within a specified geographical area. This area may be specified either as a rectangle or as a polygon. Options also exist to extract (i) all the records for the seismic line if any of the line crosses the area (ii) that part of the line that crosses the area and (iii) the line only if the whole line lies within the area. A further program that can be run is ISECT, which determines all seismic line intersections in the file produced.

Files may be resampled to suit certain requirements, eg. to fit onto a floppy disk or to be accepted by commercial software packages, such as Petroseis. As shot-point based data are already in ASCII format, any such process only involves resampling the file to every 10th or 20th shot (or according to the needs of the user) using UKOSAM. Standard AGSO headers are automatically changed by the program. By convention, all UKOOA source files have the extension .ASC, while derived subsampled files have the extension *.UKO.

Map Production

Time-based data

When a request comes in for a map of time-based data, it can be drawn directly from the data in the [nsp3.ti] directory using the program PSMAP. This program requires many specifications, some of which are given in the control file, which by convention is given the extension *.TIM. The control file can be created manually according to the instructions in this manual, or automatically using program CTIM.

PSMAP is a versatile program which includes the following features:

- draws ship's track with user specified symbol and annotation frequency
- draws station locations with up to three data values at each station
- draws profiles of geophysical data along seismic lines and ship's track
- can plot ship's track only where a particular type of geophysical data exists
- interprets and draws data from VMS floating point files as well as UKOOA ASCII shot-point based files on the same map
- uses UTM, Mercator, Simple Conic and Lambert's Conformal projections
- allows use of colour and linestyle
- allows plotting of placenames, tenement boundaries, well locations, coastlines, bathymetric contours and continental shelf and ZOCA boundaries
- allows various settings for map base

- has access to survey information in the file *SURVDEF.ASC* and writes a log file of map contents
- can plot streamer locations

PSMAP generates a CGM format plot file, which is passed to the plotting hardware or can be viewed as a screen display, via Petroseis.

Shot-based data

Requests for maps of shot-based data can also be plotted using PSMAP by directly reading the data from the [nsp3.uk] directory. In a similar way to time-based files, a control file may either be created manually or automatically using STIM. STIM creates a .TIM file containing the names of all survey files in the UKOOA database whose bounding geographical limits overlap the search area specified.

Some of the options that PSMAP supports are to: only include particular lines from the survey, distinguish lines and surveys by colour and style, double the plot strength of specified lines and only plot every nth shot to the .CGM file.

While PSMAP will handle UKOOA format files, a better tool for mapping shot-based data is Petroseis, whose only limitation is that it can't draw profiles along a ship's track. Petroseis can also be used to plot time-based data if it can be 'tricked' into accepting a derivative of the time index as a shotpoint number. The programs that output time-based files to such an ASCII format are PUKOUT, UKODAY and MAKEDB.

Passing the Data On

If a magnetic medium is required for the data file product, affix a suitable standard label, copy the file to the medium and have it checked by the processing supervisor before passing it to the Information Services Group (ISG) supervisor. If the data is to be "ftp"ed to an external client, approval should be sought from a supervising officer.

ALL DATA TO EXTERNAL CLIENTS MUST GO THROUGH

EXTERNAL LIAISON.

Maps will require associated documentation on map contents, which is generated by either GDAT or PSMAP as log files. Edit these to suit the job.

Since the advent of contract seismic surveys and the need to provide the processed products for the client as soon as possible after the completion of the job, the final non-seismic data are produced for the client on tape and sent directly to the client through/from Ship Operations Group.