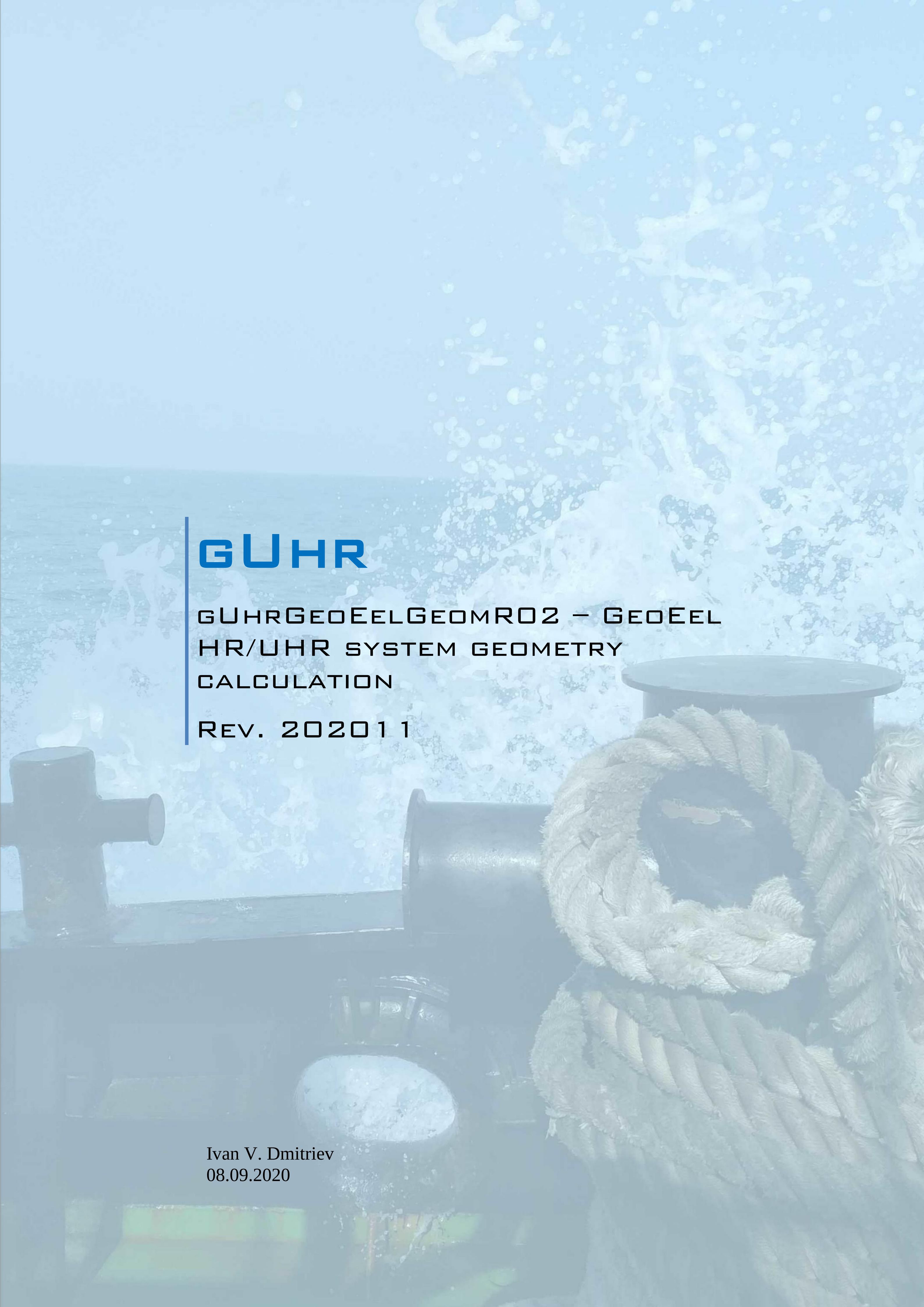

gUhr

gUhrGeoEelGeomR02 – GeoEel HR/UHR system geometry calculation

Rev. 202011

Ivan V. Dmitriev
08.09.2020

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List of changes

02 May 2019 – Document's revision 1 was created: seismic source position (Dmitriev I.V.)

17 May 2019 – Appendix 2 and Appendix 3 are added (Kozhemyakin I.I.)

28 October 2020 – Document's revision 2 was created: seismic source and channels simplified position (Dmitriev I.V.)

06 November 2020 – Appendix 2 and Appendix 3 are corrected (Kozhemyakin I.I.)

08 November 2020 – Document's revision 2 was checked (Dmitriev I.V.)

1 General overview

The current document presents procedure’s description for 2D High Resolution Seismic marine survey geometry calculation and Nav-merged Sgy creation. The procedure is realized as a script for MatLab, using ge0mlib library.

The script has the follow **features/limitations**:

1) The GeoEel seismic station and GunLink2000 are used (script read equipment’s log-files).
2) The script creates for equipment-set which includes:
   -- single streamer with (a) a number of data-channels, (b) a number of aux-channels, (c) one tail buoy, (d) a number of compass and depth birds; the streamer configuration, used in the Example’s data is shown in Figure 1.
   -- gun-system with (a) single guns-cluster with a number of guns, depth sensor and near-field hydrophone sent to aux-channel of seismic station, (b) manifold pressure sensor, (c) atmospheric pressure sensor.
3) The streamer is relatively short and linear-when-towed. It is approximate as a line from towpoint to tail-buoy every fix-time.
4) The cluster’s position calculated using streamer direction and umbilical cable length (there are no GPS installed with cluster).
5) The cluster position is forward relative seismic channel No1 (Sgy header offset sign not calculate but set negative).
6) The survey data write to Sgy-file.

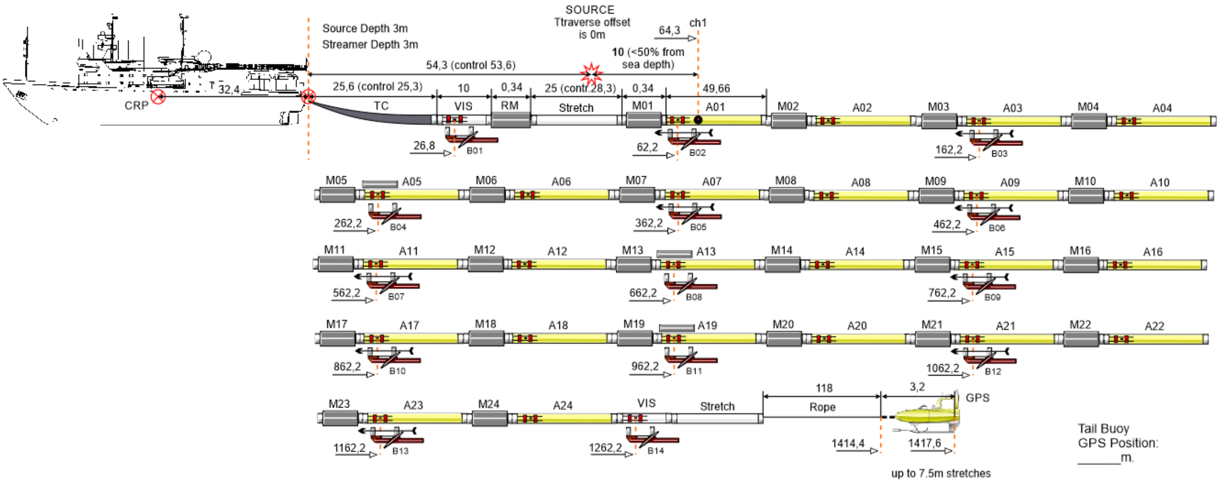


Figure 1. The seismic streamer configuration used in Examples data

The follow **input data** needs for 2D HR geometry calculation:

1) streamer’s towpoint position with 1-second period; page 17;
2) cluster towpoint position with 1-second period; page 14;
3) tail-buoy position with 1-secont period; page 14;
4) birds log (used exported from Qinsy); page 11;
5) GeoEel seismic station’s three txt-logs (Nav for shots log, Depth log, Tension log); page 15;
6) GunLink txt-log (includes shots time, cluster depth, pressure, synchronization errors, etc.); page 12;

7) MBES survey "belt" for current seismic line; page 11;
8) Sgy-file created by GeoEel seismic station; page 17;
9) txt-file with P1/90 header template; page 52;
10) txt-file with Sgy's text-header template; page 57.

The Geometry calculation procedure presents follow **output results**:
-- P1/90 file with seismic source position (and script for AutoCad's track-plot); page 52;
-- Catalogue txt-file with coordinates, for source position defined points step; page 55;
-- P1/90 file with 1st CMP position (and script for AutoCad's track-plot); page 52;
-- Catalogue txt-file with coordinates, for 1st CMP position defined points step; page 55;
-- txt-file contained "2D Marine geometry spreadsheet for ProMax" by seismic source; page 56;
-- Sgy-file with nav-merged data, which contained: source/receivers positions and depth, actual sea depth for survey, guns and seismic birds own data; page 57.

The Sgy-file fields and headers mainly formatted in accordance with Exxon Mobile requirements presented below in "Appendix 1: Raw 2D marine SEG-Y data requirements by Exxon Mobile".

The script is realized **12 commands**:
-- 'SU_Set' – define setup data for project (SU variable); page 35;
-- 'ML_Set' – load "map layers" for project (ML variable); page 35;
-- 'Main_Load' – load project's workspace (PR variable with survey lines data and ML); page 36;
-- 'Main_Save' –save project's workspace (PR variable with survey lines data and ML); page 36;
-- 'PR_Set' – load survey line logs and data from input files to project's workspace (to PR variable); page 36;
-- 'Fix&Shot_QC' – visual control Fix and Shots (FFID) correlation; page 37;
-- 'Time_QC' – spike control and smoothing for time; page 41;
-- 'Coord_QC' – spike control and smoothing for coordinates; page 43;
-- 'PR_CreateSet' – interpolate survey line data to Fix time and calculate additional parameters (streamer feather angle, receivers' depth and coordinates, etc.); used PR{...}.Z field; page 48;
-- 'OutPromaxGunGeom' – export synchronized data from PR{...}.Z field to output file with "2D Marine geometry spreadsheet for ProMax"; page 50;
-- 'OutP190Geom' – export synchronized data from PR{...}.Z field to P1/90 file, AutoCad's script file, Catalogue file; page 50;
-- 'OutSgyGeom' – export synchronized data from PR{...}.Z field to Sgy-fields (Text header, Binary Header, Traces Headers) and save it to output Sgy-file with nav-merged data; page 51.

The typical MatLab session for '0006_C_L_HR_29' survey line's geometry processing is shown in Figure 2. The survey line logs and Sgy are loaded to cell PR{1}.

The 'Time_QC' and 'Coord_QC' run for data 'StTp' (streamer towpoint), 'StBuoy' (streamer's tailbuoy) and 'GunTp' (seismic cluster towpoint).

```
Command Window
>> {'SU_Set'};gUhrGeoEelGeomR02;
>> {'ML_Set'};gUhrGeoEelGeomR02;
ML(1)=LPlan_2DHR.txt; Format: LinePlan - LinePlaning Loaded; AutoCad file created
>> {'PR_Set','0006_C_L_HR_29',26,1};gUhrGeoEelGeomR02;
Current settings: FileNamesMainPart=0006_C_L_HR_29; LineDirection=26; LineNumber=1
-- Bathy belt get;
-- Streamer logs get: TowPoint, Buoy, Log, RepeaterDepth, Tension;
-- Gun logs get: TowPoint, Log;
-- Bird log get;
-- Sgy get.
>> {'Fix&Shot_QC',1};gUhrGeoEelGeomR02;
>> {'Time_QC','StTp','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'Coord_QC','StTp','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'Time_QC','StBuoy','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'Coord_QC','StBuoy','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'Time_QC','GunTp','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'Coord_QC','GunTp','Gps',1,1:1};gUhrGeoEelGeomR02;
>> {'PR_CreateSet',1};gUhrGeoEelGeomR02;
>> {'OutPromaxGunGeom',1};gUhrGeoEelGeomR02;
>> {'OutP190Geom','Gun',2018,1,10,'S'};gUhrGeoEelGeomR02;
CatStep=10
RecordId=S
File num: 1; File name:d:\UHR_GeoEel\\P190_GunHeader.txt
Warning: gP190Write: Head.LineName length must be 12; the right part was deleted
file:d:\UHR_GeoEel\\0006_C_L_HR_29\calc_0006_C_L_HR_29_Gun.190
> In gP190Write (line 80)
  In gUhrGeoEelGeomR02 (line 343)
>> {'OutP190Geom','Cmp1',2018,1,10,'C'};gUhrGeoEelGeomR02;
CatStep=10
RecordId=C
File num: 1; File name:d:\UHR_GeoEel\\P190_Cmp1Header.txt
Warning: gP190Write: Head.LineName length must be 12; the right part was deleted
file:d:\UHR_GeoEel\\0006_C_L_HR_29\calc_0006_C_L_HR_29_Cmp1.190
> In gP190Write (line 80)
  In gUhrGeoEelGeomR02 (line 343)
>> {'OutSgyGeom',1};gUhrGeoEelGeomR02;
Warning gSgyWrite: There was IEEE to IBM conversion error.
>> {'Main_Save'};gUhrGeoEelGeomR02;
MAIN_GEOM.mat - PR & ML variables Saved
>>
```

Figure 2. MatLab session for '0006_C_L_HR_29' survey line's geometry processing

The Line name '0006_C_L_HR_29' is longer than 12 chars defined for P1/90 standard. The scripts write warning and cut Line name in right.

The commands 'OutPromaxGunGeom', 'OutP190Geom', 'OutSgyGeom' creates 8 output files. The Sgy size is about 1.1Gb; the session time is about 10 minutes (the most time was spent for tailbuoy's coordinates spikes deleting).

The quick script's command description is presented in Script's commands Quick Start.

2 Input files

The 2DHR input data located in the “Root folder”. The Root contained sub-folders with survey lines and a number of txt-files there are

-- File with line-planning;

-- Files with headers template for P1/90 (for example, templates for Gun and for CMP1);

-- Files with headers template for Sgy.

The survey line’s sub-folder contained files are used for geometry calculation, with the follow postfixes and extensions:

-- _Bathy.txt – the MBES data “belt” surveyed with 2DHR data (exported from Qinsy);

-- _BirdLog.txt – the seismic birds log-file (exported from Qinsy);

-- _GunLog.txt – the GunLink2000 log-file (created by GunLink2000 software);

-- _GunTp.txt – the seismic cluster towpoint coordinates (1-second step; exported from Qinsy);

-- _StBuoy.txt – the tail buoy coordinates (1-second step; exported from Qinsy);

-- _StDpt.txt – the GeoEel streamer depth sensor from repeater (created by station’s software);

-- _StNav.txt – the GeoEel streamer navigation log (created by station’s software);

-- _StTens.txt – the GeoEel streamer tension log (created by station’s software);

-- _StTp.txt – the streamer towpoint coordinates (1-second step; exported from Qinsy);

-- .sgy – the data recorded by GeoEel seismic station.

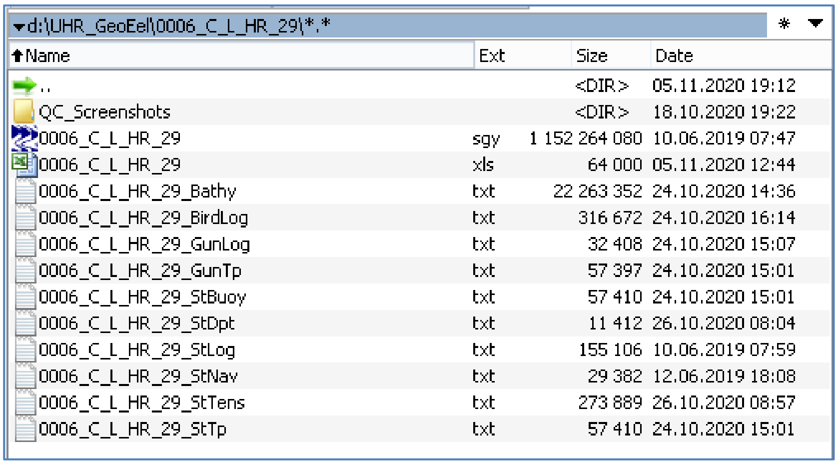
The survey line’s sub-folder contained additional folder and files are used for QC only. There are:

-- QC_Screenshots – the sub folder with QC-screenshots;

-- _StLog.txt – the GeoEel seismic station Log-file;

-- .xls – the on-line log for current survey line.

The first part of files and sub-folder name are the survey line name. The example is shown in figure below (Figure 3).


d:\UHR_GeoEel\0006_C_L_HR_29*.*

Name	Ext	Size	Date
..		<DIR>	05.11.2020 19:12
QC_Screenshots		<DIR>	18.10.2020 19:22
0006_C_L_HR_29	sgy	1 152 264 080	10.06.2019 07:47
0006_C_L_HR_29	xls	64 000	05.11.2020 12:44
0006_C_L_HR_29_Bathy	txt	22 263 352	24.10.2020 14:36
0006_C_L_HR_29_BirdLog	txt	316 672	24.10.2020 16:14
0006_C_L_HR_29_GunLog	txt	32 408	24.10.2020 15:07
0006_C_L_HR_29_GunTp	txt	57 397	24.10.2020 15:01
0006_C_L_HR_29_StBuoy	txt	57 410	24.10.2020 15:01
0006_C_L_HR_29_StDpt	txt	11 412	26.10.2020 08:04
0006_C_L_HR_29_StLog	txt	155 106	10.06.2019 07:59
0006_C_L_HR_29_StNav	txt	29 382	12.06.2019 18:08
0006_C_L_HR_29_StTens	txt	273 889	26.10.2020 08:57
0006_C_L_HR_29_StTp	txt	57 410	24.10.2020 15:01

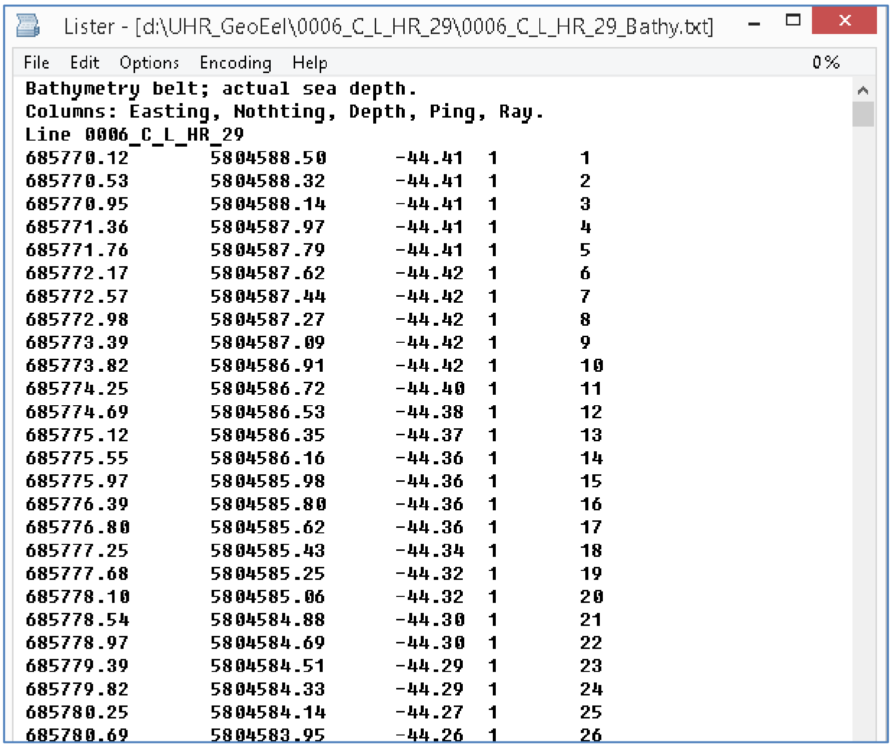
Figure 3. The sub-folder content example – input data

The files data are described below.

2.1 _Bathy.txt

The file includes MBES bathymetry data, surveyed with current Line and shifted to current sea surface level (without tide correction and the same). The file example is shown in Figure 4.

The file contained annotation, key-word “Line” with name of line and columns with data. The data includes follow columns: Easting, Northing, Depth (actual sea depth water surface to bottom), MBES ping number, MBES ray number.



Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_Bathy.txt]

File Edit Options Encoding Help 0%

```
Bathymetry belt; actual sea depth.
Columns: Easting, Nothting, Depth, Ping, Ray.
Line 0006_C_L_HR_29
685770.12	5804588.50	-44.41	1	1
685770.53	5804588.32	-44.41	1	2
685770.95	5804588.14	-44.41	1	3
685771.36	5804587.97	-44.41	1	4
685771.76	5804587.79	-44.41	1	5
685772.17	5804587.62	-44.42	1	6
685772.57	5804587.44	-44.42	1	7
685772.98	5804587.27	-44.42	1	8
685773.39	5804587.09	-44.42	1	9
685773.82	5804586.91	-44.42	1	10
685774.25	5804586.72	-44.40	1	11
685774.69	5804586.53	-44.38	1	12
685775.12	5804586.35	-44.37	1	13
685775.55	5804586.16	-44.36	1	14
685775.97	5804585.98	-44.36	1	15
685776.39	5804585.80	-44.36	1	16
685776.80	5804585.62	-44.36	1	17
685777.25	5804585.43	-44.34	1	18
685777.68	5804585.25	-44.32	1	19
685778.10	5804585.06	-44.32	1	20
685778.54	5804584.88	-44.30	1	21
685778.97	5804584.69	-44.30	1	22
685779.39	5804584.51	-44.29	1	23
685779.82	5804584.33	-44.29	1	24
685780.25	5804584.14	-44.27	1	25
685780.69	5804583.95	-44.26	1	26
```

Figure 4. _Bathy.txt data example

2.2 _BirdLog.txt

The file includes birds data exported from Qinsy. The columns number depends from birds’ data and type. The file example is shown in Figure 5.

The file contained annotation, key-word “Line” with name of line and columns with data. The types of data example for Figure 5:

-- Measure date and time;
-- Seismic Fix number, took place;
-- Magnetic azimuth for compass birds;
-- Water depth for leveler birds;
-- Wings angle;
-- Temperature.

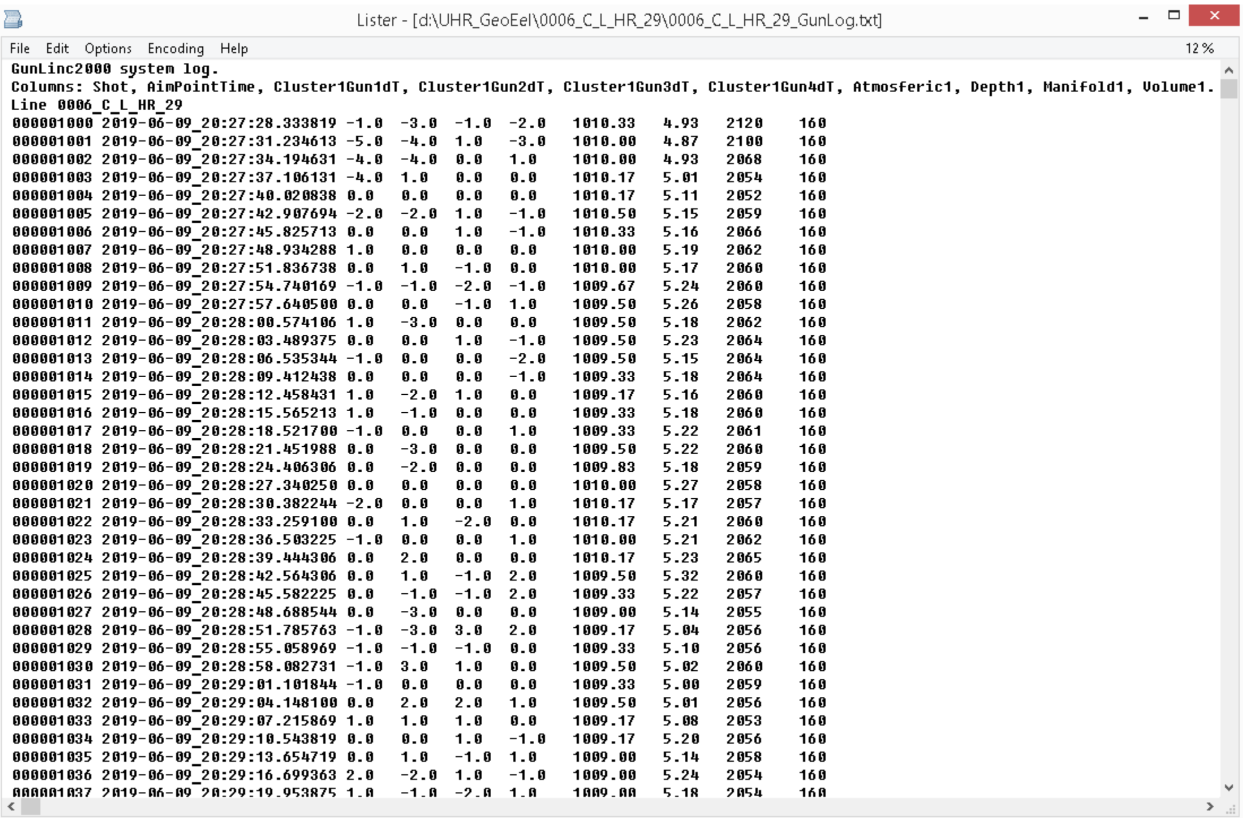
The rows generated by DigiCourse system with defined time-interval and repeat by Qinsy each second.

```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_BirdLog.txt]
File  Edit  Options  Encoding  Help                                                   1 %
Field 01= Date
Field 02= Time
Field 03= Fix Number
Field 04= Compass_01 Value
Field 05= Compass_02 Value
Field 06= Compass_05 Value
Field 07= Compass_06 Value
Field 08= Compass_08 Value
Field 09= Compass_09 Value
Field 10= Compass_11 Value
Field 11= Compass_12 Value
Field 12= Depth_Bird_01 Value
Field 13= Depth_Bird_02 Value
Field 14= Depth_Bird_03 Value
Field 15= Depth_Bird_04 Value
Field 16= Depth_Bird_05 Value
Field 17= Depth_Bird_06 Value
Field 18= Depth_Bird_07 Value
Field 19= Depth_Bird_08 Value
Field 20= Depth_Bird_09 Value
Field 21= Depth_Bird_10 Value
Field 22= Depth_Bird_11 Value
Field 23= Depth_Bird_12 Value
Field 24= Depth_Bird_13 Value
Field 25= Angle_01 Value
Field 26= Angle_02 Value
Field 27= Angle_03 Value
Field 28= Angle_04 Value
Field 29= Angle_05 Value
Field 30= Angle_06 Value
Field 31= Angle_07 Value
Field 32= Angle_08 Value
Field 33= Angle_09 Value
Field 34= Angle_10 Value
Field 35= Angle_11 Value
Field 36= Angle_12 Value
Field 37= Angle_13 Value
Field 38= Temperature_01 Value
Field 39= Temperature_02 Value
Field 40= Temperature_03 Value
Field 41= Temperature_04 Value
Field 42= Temperature_05 Value
Field 43= Temperature_06 Value
Field 44= Temperature_07 Value
Field 45= Temperature_08 Value
Field 46= Temperature_09 Value
Field 47= Temperature_10 Value
Field 48= Temperature_11 Value
Field 49= Temperature_12 Value
Field 50= Temperature_13 Value
Line 0006_C_L_HR_29
20190609        202719.00       996     33.80   33.50   34.10   33.80   33.40   33.10   33.10   32.40   1
20190609        202720.00       997     33.80   33.50   34.10   33.80   33.40   33.10   33.10   32.40   1
20190609        202721.00       997     33.80   33.50   34.10   33.80   33.40   33.10   33.10   32.40   1
20190609        202722.00       997     33.80   33.70   34.00   33.40   33.80   33.30   33.00   32.40   1
20190609        202723.00       998     33.80   33.70   34.00   33.40   33.80   33.30   33.00   32.40   1
20190609        202724.00       998     33.80   33.70   34.00   33.40   33.80   33.30   33.00   32.40   1
20190609        202725.00       998     33.80   33.70   34.00   33.40   33.80   33.30   33.00   32.40   1
20190609        202726.00       999     33.80   33.70   34.00   33.40   33.80   33.30   33.00   32.40   1
20190609        202727.00       999     33.80   33.80   33.80   33.40   33.70   33.00   32.50   32.60   2
20190609        202728.00       1000    33.80   33.80   33.80   33.40   33.70   33.00   32.50   32.60   2
```

Figure 5. _BirdLog.txt data example

2.3 _GunLog.txt

The file includes GunLog data created by GunLink2000 software. The columns number depends from cluster numbers, guns numbers for cluster, sensors installed to GunLink2000 system. The file example is shown in Figure 6.



Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_GunLog.txt]

File Edit Options Encoding Help 12 %

```
GunLinc2000 system log.
Columns: Shot, AimPointTime, Cluster1Gun1dT, Cluster1Gun2dT, Cluster1Gun3dT, Cluster1Gun4dT, Atmosferic1, Depth1, Manifold1, Volume1.
Line 0006_C_L_HR_29
000001000 2019-06-09_20:27:28.333819 -1.0  -3.0  -1.0  -2.0   1010.33   4.93   2120    160
000001001 2019-06-09_20:27:31.234613 -5.0  -4.0  1.0   -3.0   1010.00   4.87   2100    160
000001002 2019-06-09_20:27:34.194631 -4.0  -4.0  0.0   1.0    1010.00   4.93   2068    160
000001003 2019-06-09_20:27:37.106131 -4.0  1.0   0.0   0.0    1010.17   5.01   2054    160
000001004 2019-06-09_20:27:40.020838 0.0   0.0   0.0   0.0    1010.17   5.11   2052    160
000001005 2019-06-09_20:27:42.907694 -2.0  -2.0  1.0   -1.0   1010.50   5.15   2059    160
000001006 2019-06-09_20:27:45.825713 0.0   0.0   1.0   -1.0   1010.33   5.16   2066    160
000001007 2019-06-09_20:27:48.934288 1.0   0.0   0.0   0.0    1010.00   5.19   2062    160
000001008 2019-06-09_20:27:51.836738 0.0   1.0   -1.0  0.0    1010.00   5.17   2060    160
000001009 2019-06-09_20:27:54.740169 -1.0  -1.0  -2.0  -1.0   1009.67   5.24   2060    160
000001010 2019-06-09_20:27:57.640500 0.0   0.0   -1.0  1.0    1009.50   5.26   2058    160
000001011 2019-06-09_20:28:00.574106 1.0   -3.0  0.0   0.0    1009.50   5.18   2062    160
000001012 2019-06-09_20:28:03.489375 0.0   0.0   1.0   -1.0   1009.50   5.23   2064    160
000001013 2019-06-09_20:28:06.535344 -1.0  0.0   0.0   -2.0   1009.50   5.15   2064    160
000001014 2019-06-09_20:28:09.412438 0.0   0.0   0.0   -1.0   1009.33   5.18   2064    160
000001015 2019-06-09_20:28:12.458431 1.0   -2.0  1.0   0.0    1009.17   5.16   2060    160
000001016 2019-06-09_20:28:15.565213 1.0   -1.0  0.0   0.0    1009.33   5.18   2060    160
000001017 2019-06-09_20:28:18.521700 -1.0  0.0   0.0   1.0    1009.33   5.22   2061    160
000001018 2019-06-09_20:28:21.451988 0.0   -3.0  0.0   0.0    1009.50   5.22   2060    160
000001019 2019-06-09_20:28:24.406306 0.0   -2.0  0.0   0.0    1009.83   5.18   2059    160
000001020 2019-06-09_20:28:27.340250 0.0   0.0   0.0   0.0    1010.00   5.27   2058    160
000001021 2019-06-09_20:28:30.382244 -2.0  0.0   0.0   1.0    1010.17   5.17   2057    160
000001022 2019-06-09_20:28:33.259100 0.0   1.0   -2.0  0.0    1010.17   5.21   2060    160
000001023 2019-06-09_20:28:36.503225 -1.0  0.0   0.0   1.0    1010.00   5.21   2062    160
000001024 2019-06-09_20:28:39.444306 0.0   2.0   0.0   0.0    1010.17   5.23   2065    160
000001025 2019-06-09_20:28:42.564306 0.0   1.0   -1.0  2.0    1009.50   5.32   2060    160
000001026 2019-06-09_20:28:45.582225 0.0   -1.0  -1.0  2.0    1009.33   5.22   2057    160
000001027 2019-06-09_20:28:48.688544 0.0   -3.0  0.0   0.0    1009.00   5.14   2055    160
000001028 2019-06-09_20:28:51.785763 -1.0  -3.0  3.0   2.0    1009.17   5.04   2056    160
000001029 2019-06-09_20:28:55.058969 -1.0  -1.0  -1.0  0.0    1009.33   5.10   2056    160
000001030 2019-06-09_20:28:58.082731 -1.0  3.0   1.0   0.0    1009.50   5.02   2060    160
000001031 2019-06-09_20:29:01.101844 -1.0  0.0   0.0   0.0    1009.33   5.00   2059    160
000001032 2019-06-09_20:29:04.148100 0.0   2.0   2.0   1.0    1009.50   5.01   2056    160
000001033 2019-06-09_20:29:07.215869 1.0   1.0   1.0   0.0    1009.17   5.08   2053    160
000001034 2019-06-09_20:29:10.543819 0.0   0.0   1.0   -1.0   1009.17   5.20   2056    160
000001035 2019-06-09_20:29:13.654719 0.0   1.0   -1.0  1.0    1009.00   5.14   2058    160
000001036 2019-06-09_20:29:16.699363 2.0   -2.0  1.0   -1.0   1009.00   5.24   2054    160
000001037 2019-06-09_20:29:19.953875 1.0   -1.0  -2.0  1.0    1009.00   5.18   2054    160
```

Figure 6. _GunLog.txt data example

The file contained annotation, key-word “Line” with name of line and columns with data. For example’s shown in Figure 6, the GunLink system is includes:

-- one seismic cluster;

-- four guns installed to cluster (total volume 160 cu inch);

-- atmospheric pressure sensor;

-- manifold pressure sensor;

-- depth sensor installed to cluster;

-- near field hydrophone installed to cluster.

The file is contained

-- shot number generated by GunLink;

-- date and time for shot, measured by GunLink’s system (GPS with PPS pulse);

-- guns de-synchronization in microseconds;

-- atmospheric pressure in psi;

-- cluster depth in meters;

-- manifold pressure in psi;

-- cluster’s guns volume.

The rows generated for each shot.

2.4 _GunTp.txt

The file includes seismic cluster towpoint coordinates exported by Qinsy. The file example is shown in Figure 7; the rows generated for each second.

The file contained annotation, key-word “Line” with name of line and columns with data. The data includes follow columns: UTC-Date, UTC-Time, Fix (last one), Easting, Northing, Vessel’s Heading.

Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_GunTp.txt]

File Edit Options Encoding Help 4%

```
Gun towpoint position log.
Columns: Date, Time, Fix, Easting, Nothting, Vessel's Heading.
Line 0006_C_L_HR_29
20190609        202719.000      997     685821.43       5804529.65      20.39
20190609        202720.000      997     685822.31       5804531.56      20.42
20190609        202721.000      997     685823.17       5804533.50      20.42
20190609        202722.000      997     685824.05       5804535.45      20.37
20190609        202723.000      998     685824.93       5804537.40      20.36
20190609        202724.000      998     685825.79       5804539.33      20.45
20190609        202725.000      998     685826.67       5804541.25      20.51
20190609        202726.000      999     685827.57       5804543.17      20.53
20190609        202727.000      999     685828.50       5804545.10      20.48
20190609        202728.000      1000    685829.40       5804547.04      20.49
20190609        202729.000      1000    685830.32       5804548.99      20.55
20190609        202730.000      1000    685831.26       5804550.90      20.58
```

Figure 7. _GunTp.txt data example

2.5 _StBuoy.txt

The file includes tail buoy coordinates exported by Qinsy. The file example is shown in Figure 8; the rows generated for each second.

The file contained annotation, key-word “Line” with name of line and columns with data. The data includes follow columns: UTC-Date, UTC-Time, Fix (last one), Easting, Northing, Vessel’s Heading.

Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StBuoy.txt]

File Edit Options Encoding Help 4%

```
Seysmic streamer TailBuoy position log.
Columns: Date, Time, Fix, Easting, Nothting, Vessel's Heading.
Line 0006_C_L_HR_29
20190609        202719.000      996     685335.44       5803173.26      23.23
20190609        202720.000      997     685336.45       5803174.87      24.36
20190609        202721.000      997     685337.64       5803176.79      25.71
20190609        202722.000      997     685338.17       5803178.89      24.38
20190609        202723.000      998     685339.25       5803180.68      25.06
20190609        202724.000      998     685340.05       5803182.74      25.30
20190609        202725.000      998     685340.85       5803184.77      24.11
20190609        202726.000      999     685341.72       5803186.73      25.02
20190609        202727.000      999     685342.60       5803188.74      24.46
20190609        202728.000      1000    685343.37       5803190.45      23.96
20190609        202729.000      1000    685344.11       5803192.27      24.95
```

Figure 8. _GunTp.txt data example

2.6 _StDpt.txt

The file includes depth sensor's data which mounted in streamer's repeater module. The file example is shown in Figure 9; the rows generated for each shot.

```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StDpt.txt]
File  Edit  Options  Encoding  Help                                12 %
Seysmic streamer's Repeater depth.
Columns: Shot, Id, Depth.
Line 0006_C_L_HR_29
File: 1000, Depths: 252: 0.38m
File: 1001, Depths: 252: 0.39m
File: 1002, Depths: 252: 0.39m
File: 1003, Depths: 252: 0.39m
File: 1004, Depths: 252: 0.39m
File: 1005, Depths: 252: 0.39m
File: 1006, Depths: 252: 0.38m
```

Figure 9. _GunTp.txt data example

The file contained annotation, key-word "Line" with name of line and columns with data. The columns contains: Shot number, repeater ID, depth in meters.

2.7 _StLog.txt

The streamer log-file is not used for streamer navigation calculation. It includes information about survey line, noise tests results, shots (files) numbers with messages were sent from navigation system to seismic station, system alarms and errors.

The file example is shown in Figure 10.

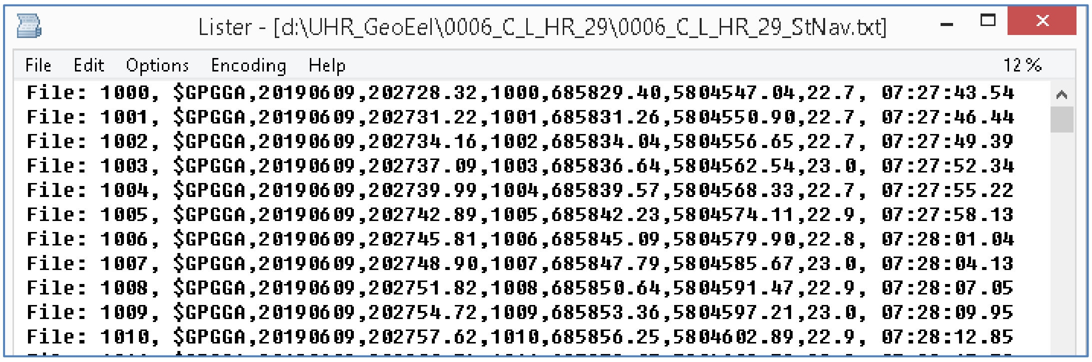
```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StLog.txt]
File  Edit  Options  Encoding  Help                                2 %
Beginning New Line - Line 0006_C_L_HR_29, Starting File Number is 996
Noise Test (File 996)...
File     996 07:24:03.18 06/10/2019 3187 KBytes SAVED IN 996.SGY
Noise Test (File Number: 996)
Survey: CSD
Line: 0006_C_L_HR_29
Date: 06/10/2019
Time: 07:24:03.18
Channel             001       002       003       004       005       006
Preamp (dB)         000       000       000       000       000       000
Noise (uBar)       3.70      3.70      2.74      3.16      2.80      2.37
                    007       008       009       010       011       012
                    000       000       000       000       000       000
                   2.95      2.72      2.65      2.13      2.32      2.19
                    013       014       015       016       017       018
                    000       000       000       000       000       000
                   2.20      2.35      2.72      2.27      2.64      2.43
                    019       020       021       022       023       024
```

```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StLog.txt]
File  Edit  Options  Encoding  Help                                21 %
                    000       000       000       000       000       000
                   1.21      0.99      0.99      0.99      1.01      1.03
                    187       188       189       190       191       192
                    000       000       000       000       000       000
                   1.29      1.11      1.03      0.92      0.90      0.92
Average Noise RMS: 1.68 uBar
$GPGGA,20192709,202728.32,1000,685829.40,5804547.04,22.7 - Received at 07:27:43.54 for File 1000
File    1000 07:27:43.43 06/10/2019 3184 KBytes SAVED IN 996.SGY
ALARM: Overdriven channels! See red traces.  07:27:45
$GPGGA,20192709,202731.22,1001,685831.26,5804550.90,22.7 - Received at 07:27:46.44 for File 1001
ALARM: Gun amplitude threshold exceeded.  07:27:48
File    1001 07:27:46.34 06/10/2019 3184 KBytes SAVED IN 996.SGY
ALARM: Overdriven channels! See red traces.  07:27:48
$GPGGA,20192709,202734.16,1002,685834.04,5804556.65,22.7 - Received at 07:27:49.39 for File 1002
ALARM: Gun amplitude threshold exceeded.  07:27:51
File    1002 07:27:49.29 06/10/2019 3184 KBytes SAVED IN 996.SGY
ALARM: Overdriven channels! See red traces.  07:27:51
$GPGGA,20192709,202737.09,1003,685836.64,5804562.54,23.0 - Received at 07:27:52.34 for File 1003
```

Figure 10. _StLog.txt data example

2.8 _StNav.txt

The file includes navigation data created by seismic station software. The file example is shown in Figure 11; the rows generated for each shot.



```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StNav.txt]
File  Edit  Options  Encoding  Help                                   12 %
File: 1000, $GPGGA,20190609,202728.32,1000,685829.40,5804547.04,22.7, 07:27:43.54
File: 1001, $GPGGA,20190609,202731.22,1001,685831.26,5804550.90,22.7, 07:27:46.44
File: 1002, $GPGGA,20190609,202734.16,1002,685834.04,5804556.65,22.7, 07:27:49.39
File: 1003, $GPGGA,20190609,202737.09,1003,685836.64,5804562.54,23.0, 07:27:52.34
File: 1004, $GPGGA,20190609,202739.99,1004,685839.57,5804568.33,22.7, 07:27:55.22
File: 1005, $GPGGA,20190609,202742.89,1005,685842.23,5804574.11,22.9, 07:27:58.13
File: 1006, $GPGGA,20190609,202745.81,1006,685845.09,5804579.90,22.8, 07:28:01.04
File: 1007, $GPGGA,20190609,202748.90,1007,685847.79,5804585.67,23.0, 07:28:04.13
File: 1008, $GPGGA,20190609,202751.82,1008,685850.64,5804591.47,22.9, 07:28:07.05
File: 1009, $GPGGA,20190609,202754.72,1009,685853.36,5804597.21,23.0, 07:28:09.95
File: 1010, $GPGGA,20190609,202757.62,1010,685856.25,5804602.89,22.9, 07:28:12.85
```

Figure 11. _StNav.txt data example

The row-data contained

-- shot (file) number;

-- message $GPGGA sent from navigation system to seismic station for current shot;

-- the seismic station's time.

The $GPGGA message includes:

-- date for "shot trigger" received from GunLink;

-- time for "shot trigger" received from GunLink;

-- navigation Fix number;

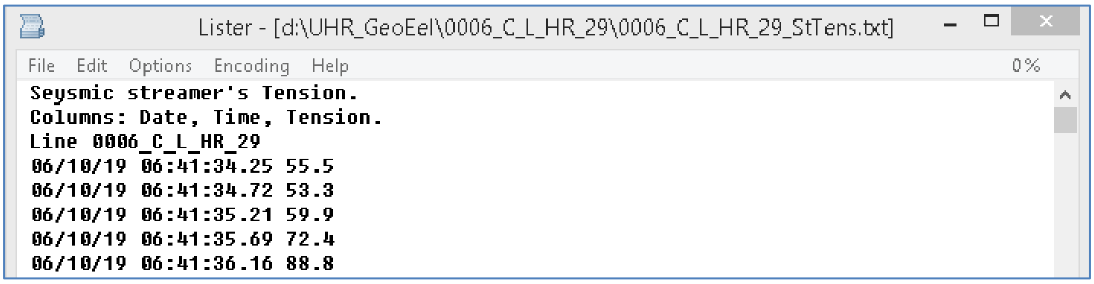
-- E and N coordinates in the start of second before shot evidence;

-- vessel's heading.

The "shot trigger" time is fixed guns-triggering-window start. Usually, we set shot-evidence at 40 millisecond after window start. It is prefer to use GunLog's time to mark shot evidence. The _StNav.txt can be used for shots (FFID) and navigation fix (Source Point Identification Number) comparison and cross-link.

2.9 _StTens.txt

The file includes streamer tension data created by seismic station software. The file example is shown in Figure 12; the rows generated with defined frequency.



```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StTens.txt]
File  Edit  Options  Encoding  Help                                   0 %
Seysmic streamer's Tension.
Columns: Date, Time, Tension.
Line 0006_C_L_HR_29
06/10/19 06:41:34.25 55.5
06/10/19 06:41:34.72 53.3
06/10/19 06:41:35.21 59.9
06/10/19 06:41:35.69 72.4
06/10/19 06:41:36.16 88.8
```

Figure 12. _StNav.txt data example

The file contained annotation, key-word “Line” with name of line and columns with data. The row-data contained

-- date by seismic station clock;

-- time by seismic station clock;

-- streamer’s tension in kg.

The tension data are generated by sensor in station’s repeater module.

2.10 _StTp.txt

The file includes seismic streamer towpoint coordinates exported by Qinsy. The file example is shown in Figure 13; the rows generated for each second.

The file contained annotation, key-word “Line” with name of line and columns with data. The data includes follow columns: UTC-Date, UTC-Time, Fix (last one), Easting, Northing, Vessel’s Heading.

```
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\0006_C_L_HR_29_StTp.txt]
File  Edit  Options  Encoding  Help                                4 %
Seysmic streamer towpoint position log.
Columns: Date, Time, Fix, Easting, Nothting, Vessel's Heading.
Line 0006_C_L_HR_29
20190609        202719.000      997     685821.43       5804529.65      20.39
20190609        202720.000      997     685822.31       5804531.56      20.42
20190609        202721.000      997     685823.17       5804533.50      20.42
20190609        202722.000      997     685824.05       5804535.45      20.37
20190609        202723.000      998     685824.93       5804537.40      20.36
20190609        202724.000      998     685825.79       5804539.33      20.45
20190609        202725.000      998     685826.67       5804541.25      20.51
20190609        202726.000      999     685827.57       5804543.17      20.53
20190609        202727.000      999     685828.50       5804545.10      20.48
20190609        202728.000      1000    685829.40       5804547.04      20.49
20190609        202729.000      1000    685830.32       5804548.99      20.55
20190609        202730.000      1000    685831.26       5804550.90      20.58
20190609        202731.000      1001    685832.19       5804552.78      20.55
20190609        202732.000      1001    685833.12       5804554.70      20.54
20190609        202733.000      1001    685834.05       5804556.65      20.55
20190609        202734.000      1002    685834.93       5804558.61      20.54
```

Figure 13. _StTp.txt data example

2.11 .sgy

The file generated by seismic station in accordance with station’s settings. The settings must be recorded manually and input to geometry calculation MatLab script.

3 Geometry calculation

3.1 Mathematics and assumption

The general features and steps of geometry calculation algorithm are described below. The detailed description includes data-fields and procedures parameters will present with the script chapter.

1) Dataset creation (linked to seismic station log Shots)

1.1) The shot-time get from _GunLog.txt-file.

1.2) The cross-link between Shots (FFID) and navigation Fix (Source Point Identification Number) get from _StNav.txt-file.

1.3) The compliance between GunLink Shots numbers (secondary) and seismic station Shots numbers (primary) controlled using UTC-time.

1.4) The all logs are combining in single dataset. There are:

-- _GunLog.txt contained primary Fix-UTC-time and secondary Shots numbers;

-- _GunLog.txt Shots numbers cross-link to seismic station Shots numbers;

-- _BirdLog.txt data interpolated to GunLog Fix-UTC-time;

-- _GunTp.txt data interpolated to GunLog Fix-UTC-time;

-- _StBuoy.txt data interpolated to GunLog Fix-UTC-time;

-- _StDpt.txt write to dataset using seismic station Shots numbers;

-- _StTens.txt data recalculate form seismic station time to UTC-time (using _StNav.txt data) and interpolate to GunLog Fix-UTC-time;

-- _StTp.txt data interpolated to GunLog Fix-UTC-time.

The result is the synchronized dataset with GunLog Fix-UTC-time and seismic station Shots numbers.

2) Geometry calculation (for each Shot)

2.1) Calculate streamer direction from streamer's towpoint coordinates to tail buoy coordinates.

2.2) Calculate guns coordinates using: cluster towpoint coordinates, streamer direction (assume that cluster umbilical towcable has the same direction), cluster umbilical towcable length.

2.3) Calculate birds' coordinates using distance from streamer's towpoint to birds and streamer direction.

2.4) Calculate streamer channels coordinate using distance from streamer's towpoint to channels and streamer direction.

2.5) Calculate CMP1 coordinates using gun and channel1 coordinates.

2.6) Calculate distance from gun to channels, using gun and channels coordinates.

3) Depth and sea depth calculation (for each object)

3.1) Set gun depth using _GunLog.txt data.

3.2) Interpolate streamer channels depth, from birds' distance along streamer to channels distance along streamer.

3.3) Interpolate sea depth from MBES-belt bathy to gun coordinates, channels coordinates, CMP1 coordinates.

3.2 Discussion

(a) The guns coordinates calculation is rough, because assume about equal streamer and umbilical towcable direction is weak. The ideally cluster must have GPS-positioning.
Another possible is calculates gun position using seismic direct wave. This can works well, if the transverse distance from gun to first's numbers of channels is comparable with "along" distance. We can "take the bearings" to gun using several channels (direct waves) and umbilical towcable length. By the data is redundant, we can create a statistical sampling of decisions and estimate the decision quality.

(b) The birds and channels coordinates calculation do not take account of streamer depth. We assume that depth is like the constant; it is mean that depth changes have not big influence to "streamer length" changes.

(c) The relative between "bird depth" measurement and sea waves needs to be understood. Is it instantaneous pressure measurement or system with "time lag"? Any case, the bird's wing algorithm includes "lag"; but is this lag apply to "depth data"?

(d) We can try to independently estimate channels depth using "frequency notches" for each shot. But we need take an account sea waves influence too.

(e) The streamer approximate as a line from towpoint to tailbuoy. It is roughly assumption. There are several ways to control and estimate streamer's bend.

(1) We can use distance towpoint to tailbuoy for general "bend" estimation.

(2) We can use direct wave to find "small bend" for near channels and "big bend" for far channels.

(3) We can use bird's compass data (but we must understand compass errors).

(4) We can estimate sea-current and use "dragging algorithm with rods" or more difficult algorithm to calculate streamer position depend current and towpoint track.

(5) The ideally we can use acoustic data (need to install transponders to streamer or acoustic birds).

4 Script using

4.1 MatLab installation

To install MatLab you need Installation Key and file with License. If you have it, in the installation window the “Use a File Installation Key” must be used (Figure 14).

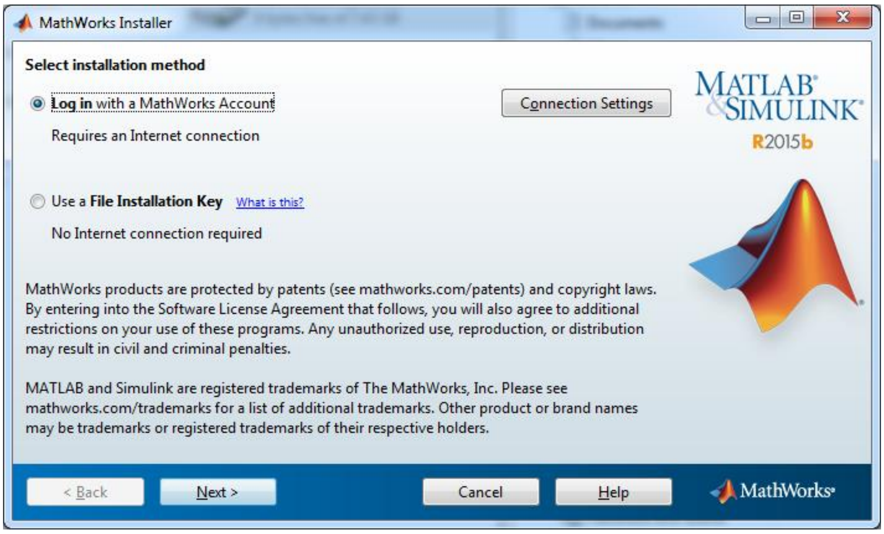


Figure 14. MatLab installation window

The next step is Toolbox choose. The ge0mlib library used minimum additional toolboxes. For some functions you need Curve fitting toolbox (function smooth), Statistical toolbox (functions nanmean, nanmin, nanmax and same).

If MatLab will run as “user”, not “admin”, it is recommend to make follow changes:

-- un-check “read only” flag for folder with MatLab installed;

-- present for “users” possible to write and change files in MatLab folder using politics.

When MatLab was running, we need to set path to library using Path Bowser (Figure 15). The selected folders with ge0mlib library and scripts need to move at bottom of path-list (Figure 16).

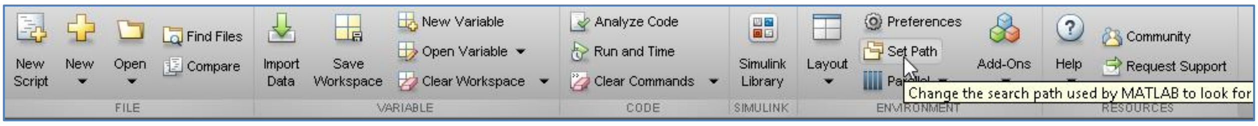


Figure 15. Path Bowser location in menu

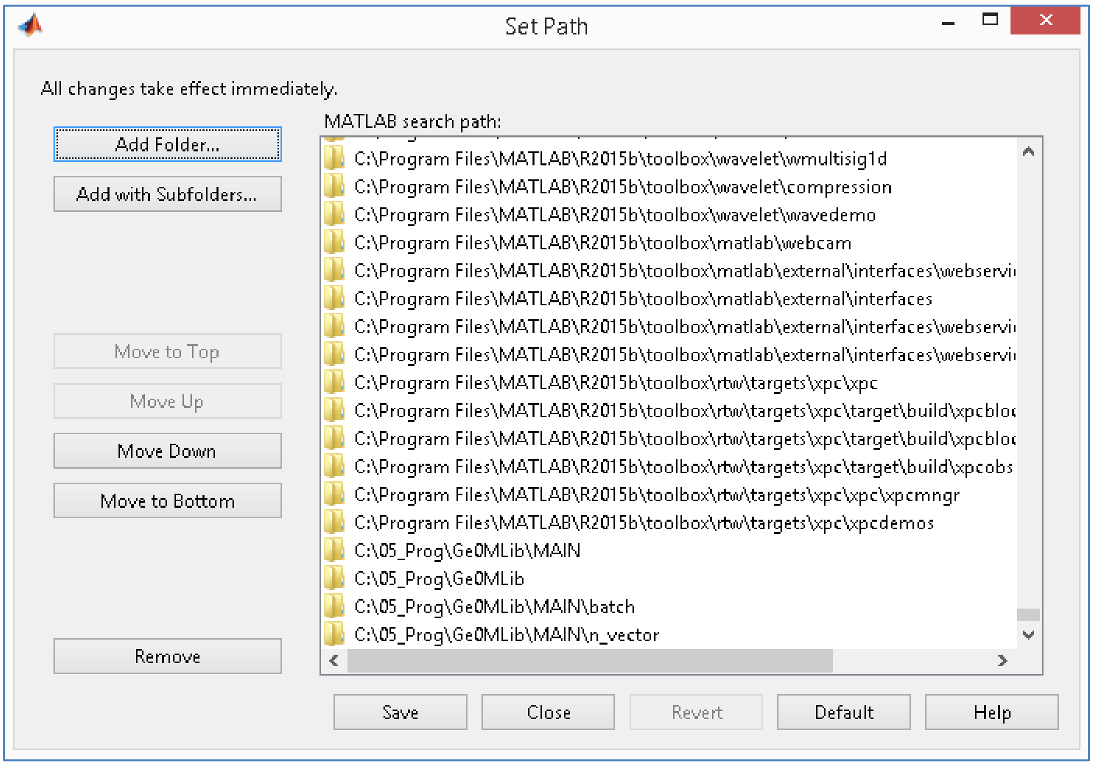


Figure 16. List of folders in Path Bowser

4.2 Script's commands Quick Start

The ge0mlib library used the special commands format for own scripts:

{'ComName',Par1,Par2,...,ParN,ParDef1,...ParDefN};ScriptName;

where

{....} – the script initialization data (command name and parameters);

ComName – the command name;

Par1..ParN – the additional data and parameters for command execution; this type of parameters is mandatory and must be defined;

ParDef1..ParDefN – the additional data and parameters for command execution; if this type of parameters is not writes in command line, than defined values wrote in the script-code are used;

ScriptName – the name of script will execute.

There is the quick start guide for gUhrGeoEelGeomR02 script commands:

{'SU_Set'};gUhrGeoEelGeomR02;

Load general Setup parameters for script.

{'ML_Set'};gUhrGeoEelGeomR02;

Define "Map layers". The current script contained only one layer, this is "Line planning".

{'Main_Load'};gUhrGeoEelGeomR02;

Load PR and ML variables with processed survey lines (or Create PR-variable).

{'PR_Set','0006_C_L_HR_29',26,1};gUhrGeoEelGeomR02;

Create dataset for single line and load Logs (see Input files) for dataset creation. The defined Line Name is 0006_C_L_HR_29. The line direction is 26 degree. The line will upload to PR-variable cell number 1.

{'Fix&Shot_QC',1};gUhrGeoEelGeomR02;

The visual Miss Shot's searching and analysis. Used survey line loaded to PR-variable cell number 1.

{'Time_QC','StTp','Gps',1,1:3};gUhrGeoEelGeomR02;

Delete spikes and smooth Time for field 'StTp' (streamer towpoint). The time postfix is 'Gps' (usually can be 'Gps' or 'Comp'). Time smooth window is 1 (no smooth). The use data in PR-variable cell number from 1 to 3.

{'Time_QC','StBuoy','Gps',1,1:3};gUhrGeoEelGeomR02;

Delete spikes and smooth Time for field 'StBuoy' (streamer buoy position). The time postfix is 'Gps' (usually can be 'Gps' or 'Comp'). Time smooth window is 1 (no smooth). The use data in PR-variable cell number from 1 to 3.

{'Time_QC','GunTp','Gps',1,1:3};gUhrGeoEelGeomR02;

Delete spikes and smooth Time for field 'GunTp' (seismic cluster towpoint). The time postfix is 'Gps' (usually can be 'Gps' or 'Comp'). Time smooth window is 1 (no smooth). The use data in PR-variable cell number from 1 to 3.

{'Coord_QC','StTp','Gps',10,1:3};gUhrGeoEelGeomR02;

Delete spike&smooth for Coordinates, field 'StTp' (streamer towpoint). The time postfix is 'Gps' (need for deleted coordinates interpolation; usually can be 'Gps' or 'Comp'). Time smooth window is 10. The use data in PR-variable cell number from 1 to 3.

{'Coord_QC','StBuoy','Gps',10,1:3};gUhrGeoEelGeomR02;

Delete spike&smooth for Coordinates, field 'StBuoy' (streamer buoy position). The time postfix is 'Gps' (need for deleted coordinates interpolation; usually can be 'Gps' or 'Comp'). Time smooth window is 10. The use data in PR-variable cell number from 1 to 3.

{'Coord_QC','GunTp','Gps',10,1:3};gUhrGeoEelGeomR02;

Delete spike&smooth for Coordinates, field 'GunTp' (seismic cluster towpoint). The time postfix is 'Gps' (need for deleted coordinates interpolation; usually can be 'Gps' or 'Comp'). Time smooth window is 10. The use data in PR-variable cell number from 1 to 3.

{'PR_CreateSet',1};gUhrGeoEelGeomR02;

The create dataset with sensors were synchronized; the dataset time is the Shots moments (see Mathematics and assumption).

{'OutPromaxGeom',1:3};gUhrGeoEelGeomR02;

Create file for ProMax with Gun position (see ProMax source geometry spreadsheet). The use data in PR-variable cell number from 1 to 3.

{'OutP190Geom','Gun',2018,1:3,10,'S'};gUhrGeoEelGeomR02;

Create file P190 and AutoCad-script for Gun position (see P1/90 and AutoCad scripts). The use data in PR-variable cell number from 1 to 3. Year 2018. The points step in catalogue-file 10. The P1/90 Record Identifier is 'S' (Source).

{'OutP190Geom','Cmp1',2018,1,10,'C'};gUhrGeoEelGeomR02;

Create file P190 and AutoCad-script for Cmp1 (see P1/90 and AutoCad scripts). The use data in PR-variable cell number from 1 to 3. Year 2018. The points step in catalogue-file 10. The P1/90 Record Identifier is 'C' (Common Mid Point).

{'OutSgyGeom',1:3};gUhrGeoEelGeomR02;

Save Sgy file with Navigation merged (see. Sgy with Navigation merged). The use data in PR-variable cell number from 1 to 3 (save three files).

{'Main_Save'};gUhrGeoEelGeomR02;

The ML and PR variables Save.

4.3 Script's variables

There are three main variables:

SU – the variable contained survey settings defined in script's code;

ML – the variable contained "map layers" (the survey line planning);

PR – the variable is the cell-vector; each cell contained single survey line data including data was loaded from input files;

PR{n}.Z – the field contained survey line data synchronized to Fix time.

4.3.1 SU – survey settings

{'SU_Set'} command create variable which contained survey settings. There are a number of variable's fields can be changed in a script code.

The first group is settings renew each time when SU_Set command execute. There are:

SU.RootDir='d:\UHR_GeoEel\';

The project's Root folder name.

SU.LPlan=1;

MapLayers's cell number contained Line Planning data (used for drawing).

SU.NavS=struct('EllipParam',[6378137 0.0818191908426215],'TargCode',2);

The survey geodetic datum.

SU.NavP=struct('EllipParam',[6378137 0.0818191908426215],'ProjParam',[0 141 0.9996 500000 0],'ProjForvFunc','gNavGeog2ProjUtm','ProjRevFunc','gNavProjUtm2Geog', 'TargCode',6);

The projection's geodetic datum. The rectangle coordinates are used for geometry calculation.

SU.CompTimeLocShift=11*3600;

Local time shift in seconds.

SU.SgyFormatForced=1;

Forced sgy format. If empty, than no forced. Used to change original file's format to another for Nav-merged file.

SU.SgyReelPos=1:4;

Prefix chars position in LineName (sequence or Reel for Sgy, contained as a prefix in LineName).

SU.Job=25;

Job identification number (JIN), Clients presented.

The second group is settings saved for each survey line in PR-variable. There are:

SU.WaterVelocity=1470;

Water velocity in m/s.

SU.NameP190GunHead='P190_GunHeader.txt';

SU.NameP190Cmp1Head='P190_Cmp1Header.txt';

SU.NameSgyTxt='Sgy_TextHeader.txt';

The names of files with headers templates.

SU.SpInterval=6.25;

Shotpoint interval in meters for 2D HR survey.

SU.GunTpNod=[];

Cluster towpoint position relative vessel's CRP.

SU.GunDist=54;

Length of cluster towcable (from towpoint to "acoustic center")

SU.StTpNod=[];

Streamer's towpoint position relative vessel's CRP.

SU.StBuoyDist=1418.4; SU.StBuoyNum=numel(SU.StBuoyDist);

Streamer length from towpoint to tail buoy. Calculated number of tail for streamer.

SU.StBirdDist=[62.2 162.2 262.2 362.2 462.2 562.2 662.2 762.2 862.2 962.2 1062.2 1162.2 1262.2]; SU.StBirdNum=numel(SU.StBirdDist);

Distance to birds from towpoint, along streamer length. Calculated number of birds for streamer.

SU.StChDist=(0:192-1).*6.25+64.3;SU.StChNum=numel(SU.StChDist);

Distance to Seismic Channels from towpoint, along streamer length. Calculated number of data channels for streamer.

SU.StAuxIdenitifactionCode=[9 3 3 3];SU.StAuxNum=numel(SU.StAuxIdenitifactionCode);

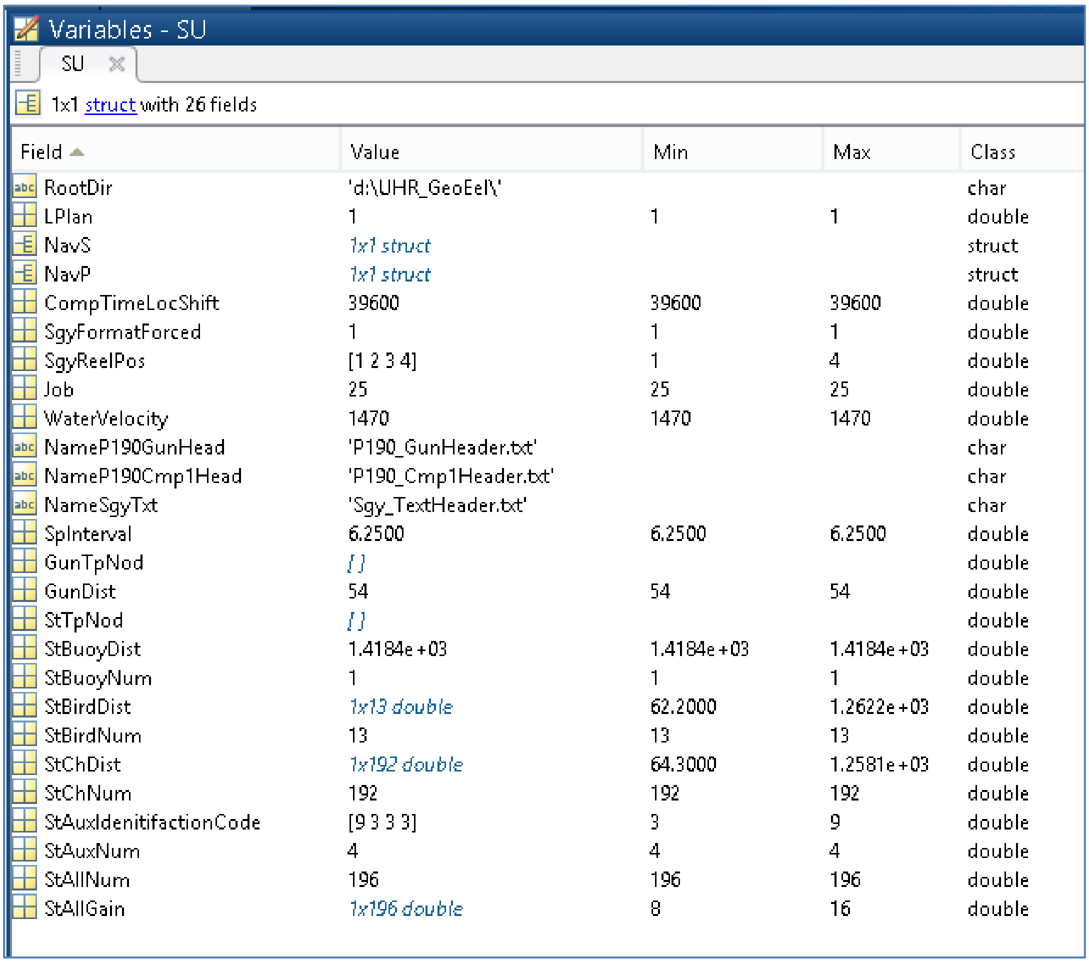
SU.StAllNum=SU.StChNum+SU.StAuxNum;

Number of aux channels. Calculated number of all channels (data and aux).

SU.StAllGain=[zeros(size(SU.StChDist))+8 16 16 16 16];

Gain for each data channel and aux channel.

The SU variable data is shown in Figure 17.



Variables - SU

SU

1x1 struct with 26 fields

Field	Value	Min	Max	Class
RootDir	'd:\UHR_GeoEel\'			char
LPlan	1	1	1	double
NavS	1x1 struct			struct
NavP	1x1 struct			struct
CompTimeLocShift	39600	39600	39600	double
SgyFormatForced	1	1	1	double
SgyReelPos	[1 2 3 4]	1	4	double
Job	25	25	25	double
WaterVelocity	1470	1470	1470	double
NameP190GunHead	'P190_GunHeader.txt'			char
NameP190Cmp1Head	'P190_Cmp1Header.txt'			char
NameSgyTxt	'Sgy_TextHeader.txt'			char
SpInterval	6.2500	6.2500	6.2500	double
GunTpNod	[ ]			double
GunDist	54	54	54	double
StTpNod	[ ]			double
StBuoyDist	1.4184e+03	1.4184e+03	1.4184e+03	double
StBuoyNum	1	1	1	double
StBirdDist	1x13 double	62.2000	1.2622e+03	double
StBirdNum	13	13	13	double
StChDist	1x192 double	64.3000	1.2581e+03	double
StChNum	192	192	192	double
StAuxIdenitifactionCode	[9 3 3 3]	3	9	double
StAuxNum	4	4	4	double
StAllNum	196	196	196	double
StAllGain	1x196 double	8	16	double

Figure 17. SU variable data

4.3.2 ML – map layers variable

{'ML_Set'} command creates the variable which contained "maps layer". There are vectors objects, raster objects, grids and the same. These objects can be used for calculations or for drawing to figure. The gUhrGeoEelGeomR02 script includes only one type of "maps layer" – the line planning (Figure 18). It is defined the follow code:

ML{SU.LPlan}.fRec='LPlan_2DHR.txt';

File with line planning data located in Root folder.

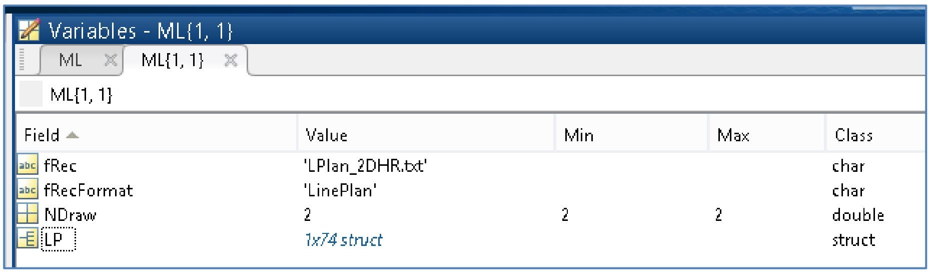
ML{SU.LPlan}.fRecFormat='LinePlan';

Defile the map-layer type 'LinePlan'.

ML{SU.LPlan}.NDraw=2;

Define the draw ordering for LinePlan.

The Line Planning draw figure is shown in Figure 17.



Variables - ML{1, 1}

ML | ML{1, 1}

ML{1, 1}

Field	Value	Min	Max	Class
fRec	'LPlan_2DHR.txt'			char
fRecFormat	'LinePlan'			char
NDraw	2	2	2	double
LP	1x74 struct			struct

Figure 18. The ML{1} variable fields

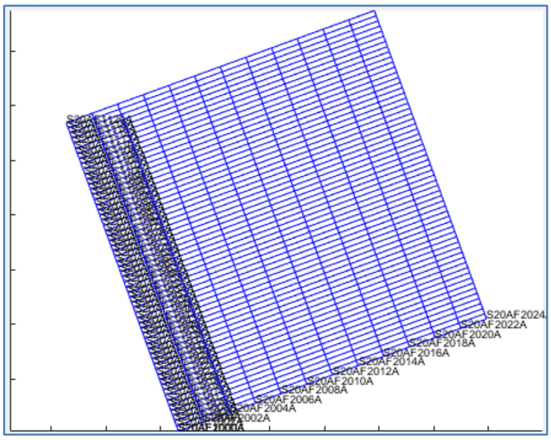


Figure 19. The Line Planning draw

4.3.3 PR – survey lines variable

{'PR_Set',...} command load input files (see Input files) to one cell for variable PR (Figure 20). The cell No1 fields are shown in Figure 21. Each field contains information about single “object” or information from single log-file.

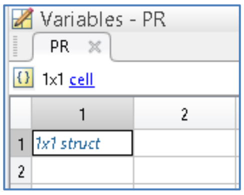
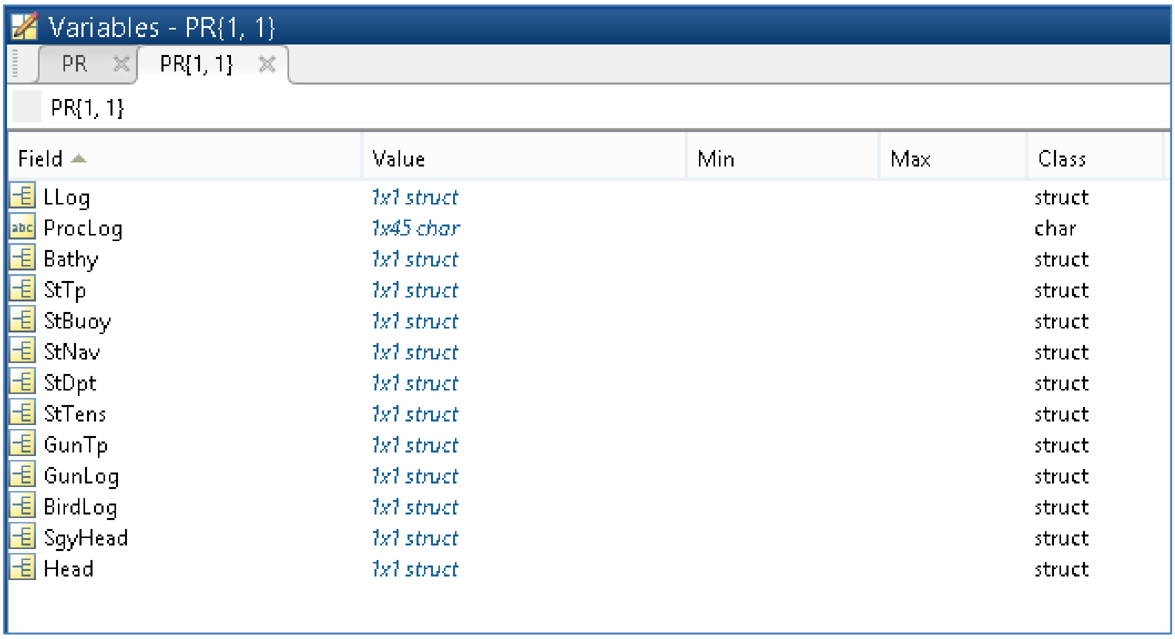


Figure 20. The PR-variable cells



Field	Value	Min	Max	Class
LLog	1x1 struct			struct
ProcLog	1x45 char			char
Bathy	1x1 struct			struct
StTp	1x1 struct			struct
StBuoy	1x1 struct			struct
StNav	1x1 struct			struct
StDpt	1x1 struct			struct
StTens	1x1 struct			struct
GunTp	1x1 struct			struct
GunLog	1x1 struct			struct
BirdLog	1x1 struct			struct
SgyHead	1x1 struct			struct
Head	1x1 struct			struct

Figure 21. Cells No1 fields

PR{n}.LLog fields are shown in Figure 22. It includes a number of fields copied from SU variable, and additional fields; there are:
LName – survey line name;

LHead – survey line direction;
ShotNum – the shot number for current survey line;
CompDay – computer's date for start and end of line (if gLog used for data logging);
CompTime – computer's time (if gLog used for data logging);
GpsDay – UTC-date for start and end of line;
GpsTime – UTC-time for start and end of line.

Variables - PR{1, 1}.LLog

PR | PR{1, 1} | PR{1, 1}.LLog

PR{1, 1}.LLog

Field	Value	Min	Max	Class
WaterVelocity	1470	1470	1470	double
NameP190GunHead	'P190_GunHeader.txt'			char
NameP190Cmp1Head	'P190_Cmp1Header.txt'			char
NameSgyTxt	'Sgy_TextHeader.txt'			char
SpInterval	6.2500	6.2500	6.2500	double
GunTpNod	[]			double
GunDist	54	54	54	double
StTpNod	[]			double
StBuoyDist	1.4184e+03	1.4184e+03	1.4184e+03	double
StBuoyNum	1	1	1	double
StBirdDist	1x13 double	62.2000	1.2622e+03	double
StBirdNum	13	13	13	double
StChDist	1x192 double	64.3000	1.2581e+03	double
StChNum	192	192	192	double
StAuxIdenitifactionCode	[9 3 3 3]	3	9	double
StAuxNum	4	4	4	double
StAllNum	196	196	196	double
StAllGain	1x196 double	8	16	double
LName	'0006_C_L_HR_29'			char
LHead	26	26	26	double
ShotNum	354	354	354	double
CompDay	[NaN NaN]	NaN	NaN	double
CompTime	[NaN NaN]	NaN	NaN	double
GpsDay	[737585 737585]	737585	737585	double
GpsTime	[7.3648e+04 7.4720e+04]	7.3648e+04	7.4720e+04	double

Figure 22. PR{n}.LLog fields

PR{n}.ProcLog contained the processing commands log for current Survey Line. There is a String.

The PR{n}.ProcLog example is shown in Figure 23. The ProcLog based MatLab session is shown in Figure 2.

```
>> PR{1, 1}.ProcLog

ans =

PR_Get# LName=0006_C_L_HR_29;  LHead=26
FixNum&ShotsNumQC#
Time_QC# fnm=StTp; fnpt=Gps; TimeSmooth=1; nn=1; BitTQH=1; flTQH=0
Coord_QC# fnm=StTp; fnpt=Gps; PosSmooth=1; BitCQH=2; flTQH=0
Time_QC# fnm=StBuoy; fnpt=Gps; TimeSmooth=1; nn=1; BitTQH=1; flTQH=0
Coord_QC# fnm=StBuoy; fnpt=Gps; PosSmooth=1; BitCQH=2; flTQH=0
Time_QC# fnm=GunTp; fnpt=Gps; TimeSmooth=1; nn=1; BitTQH=1; flTQH=0
Coord_QC# fnm=GunTp; fnpt=Gps; PosSmooth=1; BitCQH=2; flTQH=0
PR_CreateSet#
OutPromaxGunGeom# SrcPattern0=1; Static0=0
OutP190Geom# CoordinateFieldPrefix=Gun; P190HeadYear=2018; CatStep=10; RecordId=S; Spare1=   ; VesselId=1; SourceId=1; OtherId=1; Spare2= ; WCode=NNMMM
OutP190Geom# CoordinateFieldPrefix=Cmp1; P190HeadYear=2018; CatStep=10; RecordId=C; Spare1=   ; VesselId=1; SourceId=1; OtherId=1; Spare2= ; WCode=NNMM
OutSgyGeom#

>>
```

Figure 23. PR{n}.ProcLog example

PR{n}.Bathy fields are shown in Figure 24. It includes the _Bathy.txt file data (see _Bathy.txt).

Variables - PR{1, 1}.Bathy

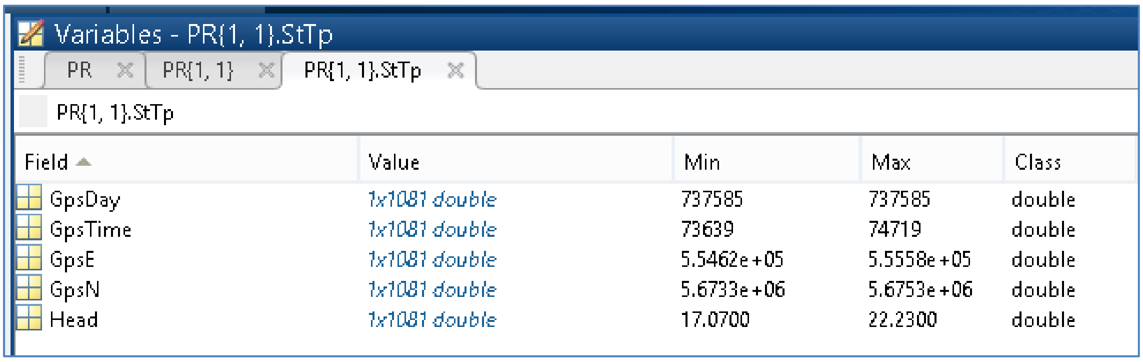
PR | PR{1, 1} | PR{1, 1}.Bathy

PR{1, 1}.Bathy

Field	Value	Min	Max	Class
GpsE	1x595382 double	<Too many ele...	<Too many...	double
GpsN	1x595382 double	<Too many ele...	<Too many...	double
Depth	1x595382 double	<Too many ele...	<Too many...	double

Figure 24. PR{n}.Bathy fields

PR{n}.StTp fields are shown in Figure 25. It includes the _StTp.txt file data (see _StTp.txt).



Variables - PR{1, 1}.StTp

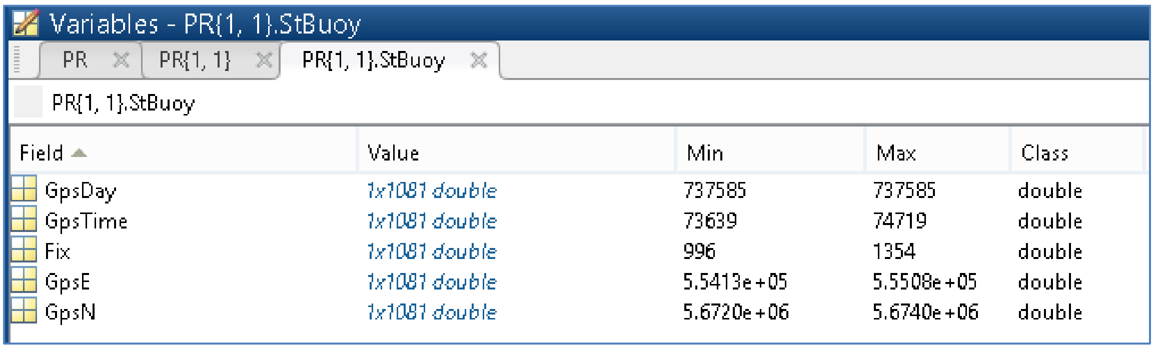
PR | PR{1, 1} | PR{1, 1}.StTp

PR{1, 1}.StTp

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
GpsE	1x1081 double	5.5462e+05	5.5558e+05	double
GpsN	1x1081 double	5.6733e+06	5.6753e+06	double
Head	1x1081 double	17.0700	22.2300	double

Figure 25. PR{n}.StTp fields

PR{n}.StBuoy fields are shown in Figure 26. It includes the _StBuoy.txt file data (see _StBuoy.txt).



Variables - PR{1, 1}.StBuoy

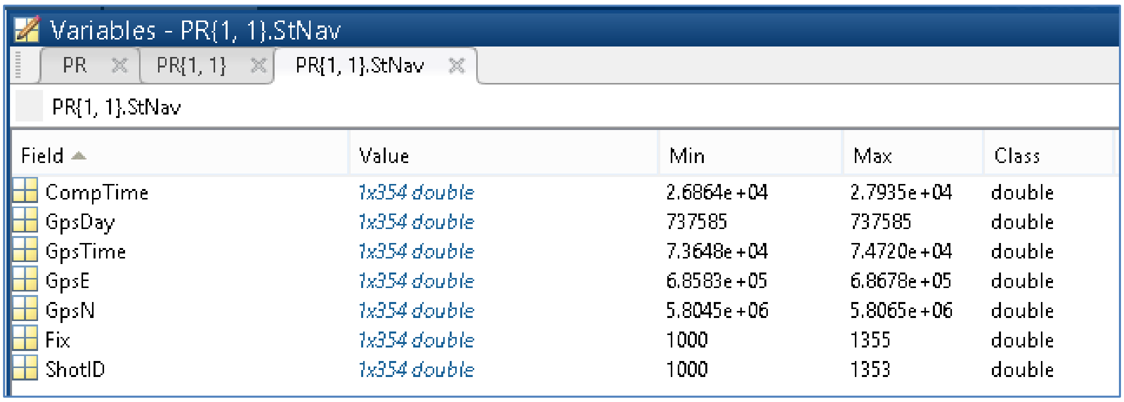
PR | PR{1, 1} | PR{1, 1}.StBuoy

PR{1, 1}.StBuoy

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
Fix	1x1081 double	996	1354	double
GpsE	1x1081 double	5.5413e+05	5.5508e+05	double
GpsN	1x1081 double	5.6720e+06	5.6740e+06	double

Figure 26. PR{n}.StBuoy fields

PR{n}.StNav fields are shown in Figure 27. It includes the _StNav.txt file data (see _StNav.txt).


Variables - PR{1, 1}.StNav

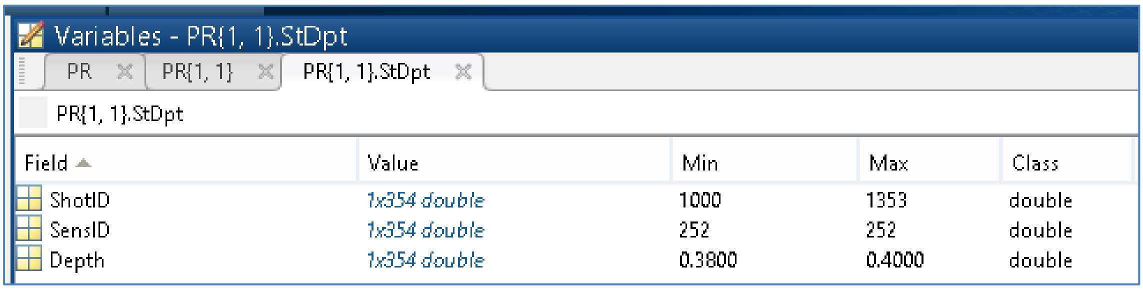
PR | PR{1, 1} | PR{1, 1}.StNav

PR{1, 1}.StNav

Field	Value	Min	Max	Class
CompTime	1x354 double	2.6864e+04	2.7935e+04	double
GpsDay	1x354 double	737585	737585	double
GpsTime	1x354 double	7.3648e+04	7.4720e+04	double
GpsE	1x354 double	6.8583e+05	6.8678e+05	double
GpsN	1x354 double	5.8045e+06	5.8065e+06	double
Fix	1x354 double	1000	1355	double
ShotID	1x354 double	1000	1353	double

Figure 27. PR{n}.StNav fields

PR{n}.StDpt fields are shown in Figure 28. It includes the _StDpt.txt file data (see _StDpt.txt).


Variables - PR{1, 1}.StDpt

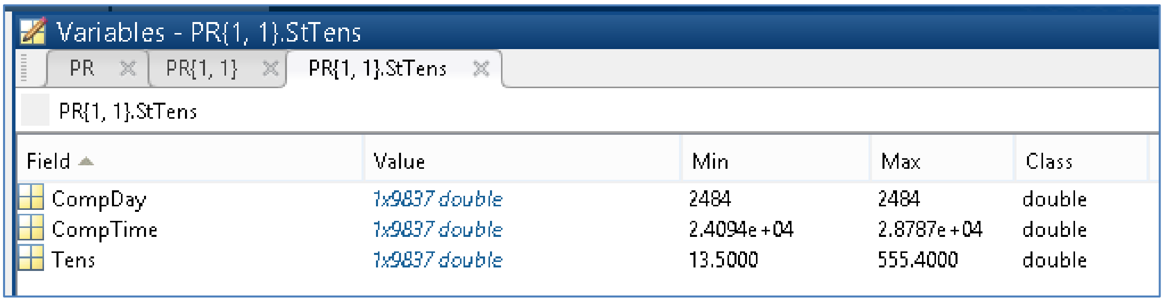
PR | PR{1, 1} | PR{1, 1}.StDpt

PR{1, 1}.StDpt

Field	Value	Min	Max	Class
ShotID	1x354 double	1000	1353	double
SensID	1x354 double	252	252	double
Depth	1x354 double	0.3800	0.4000	double

Figure 28. PR{n}.StDpt fields

PR{n}.StTens fields are shown in Figure 29. It includes the _StTens.txt file data (see _StTens.txt).


Variables - PR{1, 1}.StTens

PR | PR{1, 1} | PR{1, 1}.StTens

PR{1, 1}.StTens

Field	Value	Min	Max	Class
CompDay	1x9837 double	2484	2484	double
CompTime	1x9837 double	2.4094e+04	2.8787e+04	double
Tens	1x9837 double	13.5000	555.4000	double

Figure 29. PR{n}.StTens fields

PR{n}.GunTp fields are shown in Figure 30. It includes the _StTp.txt file data (see _GunTp.txt).

Variables - PR{1, 1}.GunTp

PR | PR{1, 1} | PR{1, 1}.GunTp

PR{1, 1}.GunTp

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
GpsE	1x1081 double	5.5462e+05	5.5558e+05	double
GpsN	1x1081 double	5.6733e+06	5.6753e+06	double
Head	1x1081 double	17.0700	22.2300	double

Figure 30. PR{n}.StTp fields

PR{n}.GunLog fields are shown in Figure 31. It includes the _GunLog.txt file data (see _GunLog.txt).

Variables - PR{1, 1}.GunLog

PR | PR{1, 1} | PR{1, 1}.GunLog

PR{1, 1}.GunLog

Field	Value	Min	Max	Class
ShotID	1x354 double	1000	1353	double
GpsDay	1x354 double	737585	737585	double
GpsTime	1x354 double	7.3648e+04	7.4720e+04	double
dTGun	4x354 double	-5	5	double
Atmosferic	1x354 double	1009	1011	double
Depth	1x354 double	3.5300	5.6800	double
Manifold	1x354 double	2022	2120	double
Volume	1x354 double	160	160	double

Figure 31. PR{n}.GunLog fields

PR{n}.BirdLog fields are shown in Figure 32. It includes the _BirdLog.txt file data (see _BirdLog.txt).

Variables - PR{1, 1}.BirdLog

PR | PR{1, 1} | PR{1, 1}.BirdLog

PR{1, 1}.BirdLog

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
Head	13x1081 double	NaN	NaN	double
Depth	13x1081 double	0.3000	6.1000	double
Angle	13x1081 double	0.7200	33.5000	double
Temper	13x1081 double	16.9100	31.6000	double

Figure 32. PR{n}.BirdLog fields

PR{n}.SgyHead fields are shown in Figure 33. It includes the .sgy file binary and text headers (see Text-header and Binary-header).

Variables - PR{1, 1}.SgyHead

PR | PR{1, 1} | PR{1, 1}.SgyHead

PR{1, 1}.SgyHead

Field	Value	Min	Max	Class
Descript	*1x1 struct*			struct
fName	'd:\UHR_GeoEel\\0006_C_L_H...			char
Endian	'b'			char
FDataSampleFormat	2	2	2	double
TextualFileHeader	*3200x1 char*			char
Job	0	0	0	double
Line	6	6	6	double
Reel	0	0	0	double
DataTracePerEnsemble	196	196	196	double
AuxiliaryTracePerEnsemble	0	0	0	double
dt	500	500	500	double
dtOrig	0	0	0	double
ns	4000	4000	4000	double
nsOrig	0	0	0	double
DataSampleFormat	2	2	2	double
EnsembleFold	0	0	0	double
TraceSorting	0	0	0	double
VerticalSumCode	0	0	0	double
SweepFrequencyStart	0	0	0	double
SweepFrequencyEnd	0	0	0	double
SweepLength	0	0	0	double
SweepType	0	0	0	double
SweepChannel	0	0	0	double
SweepTaperlengthStart	0	0	0	double
SweepTaperLengthEnd	0	0	0	double
TaperType	0	0	0	double
CorrelatedDataTraces	0	0	0	double
BinaryGain	0	0	0	double
AmplitudeRecoveryMethod	0	0	0	double
MeasurementSystem	2	2	2	double
ImpulseSignalPolarity	0	0	0	double
VibratoryPolarityCode	0	0	0	double
Unassigned1	*120x1 double*	0	0	double
SegyFormatRevisionNumber	0	0	0	double
FixedLengthTraceFlag	0	0	0	double
NumberOfExtTextualHeaders	0	0	0	double
Unassigned2	*47x1 double*	0	0	double
ExtTextualHeaders	*[]*			double
fNameTmp	'd:\UHR_GeoEel\\0006_C_L_H...			char

Figure 33. PR{n}.SgyHead fields

PR{n}.Head fields are shown in Figure 34 and Figure 35. It includes the .sgy file traces headers (see Trace-headers). Each header type is presented as a row.

Variables - PR{1, 1}.Head

PR | PR{1, 1} | PR{1, 1}.Head

PR{1, 1}.Head

Field	Value	Min	Max	Class
MessageNum	1x70952 double	1	70952	double
TraceSequenceLine	1x70952 double	0	0	double
TraceSequenceFile	1x70952 double	0	0	double
FieldRecord	1x70952 double	996	1357	double
TraceNumber	1x70952 double	1	196	double
EnergySourcePoint	1x70952 double	0	0	double
cdp	1x70952 double	0	0	double
cdpTrace	1x70952 double	0	0	double
TraceIdenitifactionCode	1x70952 double	1	1	double
NSummedTraces	1x70952 double	1	1	double
NStackedTraces	1x70952 double	1	1	double
DataUse	1x70952 double	0	0	double
offset	1x70952 double	0	0	double
ReceiverGroupElevation	1x70952 double	0	0	double
SourceSurfaceElevation	1x70952 double	0	0	double
SourceDepth	1x70952 double	0	0	double
ReceiverDatumElevation	1x70952 double	0	0	double
SourceDatumElevation	1x70952 double	0	0	double
SourceWaterDepth	1x70952 double	0	0	double
GroupWaterDepth	1x70952 double	0	0	double
ElevationScalar	1x70952 double	0	0	double
SourceGroupScalar	1x70952 double	1	1	double
SourceX	1x70952 double	0	0	double
SourceY	1x70952 double	0	0	double
GroupX	1x70952 double	0	0	double
GroupY	1x70952 double	0	0	double
CoordinateUnits	1x70952 double	2	2	double
WeatheringVelocity	1x70952 double	0	0	double
SubWeatheringVelocity	1x70952 double	0	0	double
SourceUpholeTime	1x70952 double	0	0	double
GroupUpholeTime	1x70952 double	0	0	double
SourceStaticCorrection	1x70952 double	0	0	double
GroupStaticCorrection	1x70952 double	0	0	double
TotalStaticApplied	1x70952 double	0	0	double
LagTimeA	1x70952 double	0	0	double
LagTimeB	1x70952 double	0	0	double
DelayRecordingTime	1x70952 double	0	0	double
MuteTimeStart	1x70952 double	0	0	double
MuteTimeEnd	1x70952 double	0	0	double
ns	1x70952 double	4000	4000	double
dt	1x70952 double	500	500	double
GainType	1x70952 double	0	0	double
InstrumentGainConstant	1x70952 double	0	0	double
InstrumentInitialGain	1x70952 double	0	0	double
Correlated	1x70952 double	0	0	double

Figure 34. PR{n}.Head fields; part 1

Variables - PR{1, 1}.Head

PR | PR{1, 1} | PR{1, 1}.Head

PR{1, 1}.Head

Field	Value	Min	Max	Class
dt	*1x70952 double*	500	500	double
GainType	*1x70952 double*	0	0	double
InstrumentGainConstant	*1x70952 double*	0	0	double
InstrumentInitialGain	*1x70952 double*	0	0	double
Correlated	*1x70952 double*	0	0	double
SweepFrequenceStart	*1x70952 double*	0	0	double
SweepFrequenceEnd	*1x70952 double*	0	0	double
SweepLength	*1x70952 double*	0	0	double
SweepType	*1x70952 double*	0	0	double
SweepTraceTaperLengthStart	*1x70952 double*	0	0	double
SweepTraceTaperLengthEnd	*1x70952 double*	0	0	double
TaperType	*1x70952 double*	0	0	double
AliasFilterFrequency	*1x70952 double*	0	0	double
AliasFilterSlope	*1x70952 double*	0	0	double
NotchFilterFrequency	*1x70952 double*	0	0	double
NotchFilterSlope	*1x70952 double*	0	0	double
LowCutFrequency	*1x70952 double*	0	0	double
HighCutFrequency	*1x70952 double*	0	0	double
LowCutSlope	*1x70952 double*	0	0	double
HighCutSlope	*1x70952 double*	0	0	double
YearDataRecorded	*1x70952 double*	2019	2019	double
DayOfYear	*1x70952 double*	161	161	double
HourOfDay	*1x70952 double*	7	7	double
MinuteOfHour	*1x70952 double*	24	47	double
SecondOfMinute	*1x70952 double*	0	59	double
TimeBaseCode	*1x70952 double*	1	1	double
TraceWeightningFactor	*1x70952 double*	0	0	double
GeophoneGroupNumberRoll	*1x70952 double*	0	0	double
GeophoneGroupNumberFirstT...	*1x70952 double*	0	0	double
GeophoneGroupNumberLastT...	*1x70952 double*	0	0	double
GapSize	*1x70952 double*	0	0	double
OverTravel	*1x70952 double*	0	0	double
cdpX	*1x70952 double*	0	0	double
cdpY	*1x70952 double*	0	0	double
Inline3D	*1x70952 double*	0	0	double
Crossline3D	*1x70952 double*	0	0	double
ShotPoint	*1x70952 double*	0	0	double
ShotPointScalar	*1x70952 double*	0	0	double
TraceValueMeasurementUnit	*1x70952 double*	0	0	double
TransductionConstantMantissa	*1x70952 double*	0	0	double
TransductionConstantPower	*1x70952 double*	0	0	double
TransductionUnit	*1x70952 double*	0	0	double
TraceIdentifier	*1x70952 double*	0	0	double
ScalarTraceHeader	*1x70952 double*	0	0	double
SourceType	*1x70952 double*	0	0	double
SourceEnergyDirectionMantissa	*1x70952 double*	0	0	double
SourceEnergyDirectionExponent	*1x70952 double*	0	0	double
SourceMeasurementMantissa	*1x70952 double*	0	0	double
SourceMeasurementExponent	*1x70952 double*	0	0	double
SourceMeasurementUnit	*1x70952 double*	0	0	double
UnassignedInt1	*1x70952 double*	0	0	double
UnassignedInt2	*1x70952 double*	0	0	double

Figure 35. PR{n}.Head fields; part 2

4.3.4 PR{n}.Z – field with synchronized data

{'PR_CreateSet',...} command create PR{n}.Z field which contained the data linked to Fix (Energy source point number) and synchronized to shots time in accordance with methods described in Geometry calculation. The fields of PR{n}.Z are shown in Figure 36.

The PR{n}.Z fields are used for data export in output files using commands 'OutPromaxGunGeom', 'OutP190Geom', 'OutSgyGeom'.

Variables - PR{1, 1}.Z

PR | PR{1, 1} | PR{1, 1}.Z

PR{1, 1}.Z

Field	Value	Min	Max	Class
ShotID	1x354 double	1000	1353	double
Fix	1x354 double	1000	1355	double
GpsDay	1x354 double	737585	737585	double
GpsTime	1x354 double	7.3648e+04	7.4720e+04	double
VessHead	1x354 double	17.2289	22.1947	double
GunTpGpsE	1x354 double	5.5462e+05	5.5558e+05	double
GunTpGpsN	1x354 double	5.6733e+06	5.6753e+06	double
GunGpsE	1x354 double	5.5461e+05	5.5556e+05	double
GunGpsN	1x354 double	5.6733e+06	5.6753e+06	double
GunDepth	1x354 double	3.5300	5.6800	double
GunSeaDepth	1x354 double	43.3000	43.8334	double
dTGun	4x354 double	-5	5	double
Manifold	1x354 double	2022	2120	double
Atmosferic	1x354 double	1009	1011	double
GunVolume	1x354 double	160	160	double
StTpGpsE	1x354 double	5.5462e+05	5.5558e+05	double
StTpGpsN	1x354 double	5.6733e+06	5.6753e+06	double
StBuoyGpsE	1x354 double	5.5414e+05	5.5508e+05	double
StBuoyGpsN	1x354 double	5.6720e+06	5.6740e+06	double
StHead	1x354 double	-160.2872	-159.6803	double
StTens	1x354 double	0	0	double
StRDepth	1x354 double	0.3800	0.4000	double
StChGpsE	192x354 double	5.5420e+05	5.5556e+05	double
StChGpsN	192x354 double	5.6722e+06	5.6753e+06	double
StChDepth	192x354 double	0.3044	6.0656	double
StChSeaDepth	192x354 double	43.1648	43.9145	double
StGun2Ch	192x354 double	-1.2041e+03	-10.3807	double
Cmp1GpsE	1x354 double	5.5460e+05	5.5556e+05	double
Cmp1GpsN	1x354 double	5.6733e+06	5.6753e+06	double
Cmp1SeaDepth	1x354 double	43.3000	43.8292	double
BirdGpsE	13x354 double	5.5420e+05	5.5556e+05	double
BirdGpsN	13x354 double	5.6722e+06	5.6753e+06	double
BirdDepth	13x354 double	0.3000	6.1000	double
BirdHead	13x354 double	NaN	NaN	double
BirdAngle	13x354 double	0.7200	33.5000	double
BirdTemper	13x354 double	16.9100	31.6000	double

Figure 36. PR{n}.Z fields

4.4 Commands description

The gUhrGeoEelGeomR02 script's detailed command's description is presented below. There are 12 commands:

-- 'SU_Set' – define setup data for project (SU variable);
-- 'ML_Set' – load "map layers" for project (ML variable);
-- 'Main_Load' – load project's workspace (PR variable with survey lines data and ML);
-- 'Main_Save' –save project's workspace (PR variable with survey lines data and ML);
-- 'PR_Set' – load survey line logs and data from input files to project's workspace (to PR variable);
-- 'Fix&Shot_QC' – visual control Fix and Shots (FFID) correlation;
-- 'Time_QC' – spike control and smoothing for time;
-- 'Coord_QC' – spike control and smoothing for coordinates;
-- 'PR_CreateSet' – interpolate survey line data to Fix time and calculate additional parameters (streamer feather angle, receivers' depth and coordinates, etc.); used PR{...}.Z field.
-- 'OutPromaxGunGeom' – export synchronized data from PR{...}.Z field to output file with "2D Marine geometry spreadsheet for ProMax";
-- 'OutP190Geom' – export synchronized data from PR{...}.Z field to P1/90 file, AutoCad's script file, Catalogue file.
-- 'OutSgyGeom' – export synchronized data from PR{...}.Z field to Sgy-fields (Text header, Binary Header, Traces Headers) and save it to output Sgy-file with nav-merged data.

The ge0mlib library used the special commands format for own scripts:
{'ComName',Par1,Par2,...,ParN,ParDef1,...ParDefN};ScriptName;
where
{....} – the script initialization data (command name and parameters);
ComName – the command name;
Par1..ParN – the additional data and parameters for command execution; this type of parameters is mandatory and must be defined;
ParDef1..ParDefN – the additional data and parameters for command execution; if this type of parameters is not writes in command line, than defined values wrote in the script-code are used;
ScriptName – the name of script will execute.

4.4.1 SU_Set

{'SU_Set'};gUhrGeoEelGeomR02;

The command defines basis (setup) data for survey. The command has not any input parameters, all changes must input in to the script code. The values can be changed are described in "SU – survey settings".

4.4.2 ML_Set

{'ML_Set'};gUhrGeoEelGeomR02;

The command defines basis (setup) data for Map Layers. The command has not any input parameters, all changes must input in to the script code. The values can be changed are described in “ML – map layers variable”.

4.4.3 Main_Load

{'Main_Load'};gUhrGeoEelGeomR02;

The command load project’s workspace; there are

-- PR variable with survey lines data;

-- ML variable with Map Layers.

The variables are loaded from MAIN_GEOM.mat file located in project’s Root folder.

The command has not any input parameters. The loaded ML variable can be renewing using 'ML_Set' command.

4.4.4 Main_Save

{'Main_Save'};gUhrGeoEelGeomR02;

The command saved project’s workspace; there are

-- PR variable with survey lines data;

-- ML variable with Map Layers.

The variables are saved in MAIN_GEOM.mat file located in project’s Root folder.

The command has not any input parameters. The MAIN_GEOM.mat can be copied in other place to keep current variables state.

4.4.5 PR_Set

{'PR_Set','0006_C_L_HR_29',26,1};gUhrGeoEelGeomR02;

Load survey line (input files from line’s subfolder) to PR variable cell.

The command includes three mandatory parameters:

'0006_C_L_HR_29' – the loaded survey line name “main part”; it is general part for survey line sub-folder and files in sub folder; input from on-line log;

26 – the line surveying direction (azimuth); input from on-line log;

1 – RP-variable cell number for survey line loading (can understand as a “loaded line number”); the value must be scalar.

The MatLab window with 'PR_Set' executed is shown in Figure 37.

The loaded to PR{1} data is shown in Figure 38. The cyan points is the MBES data (points of depth measurements); the red line is seismic cluster towpoint; the blue line is streamer towpoint; the magenta line is tailbuoy position.

```
>> {'PR_Set','0006_C_L_HR_29',26,1};gUhrGeoEelGeomR02;
Current settings: FileNamesMainPart=0006_C_L_HR_29; LineDirection=26; LineNumber=1
-- Bathy belt get;
-- Streamer logs get: TowPoint, Buoy, Log, RepeaterDepth, Tension;
-- Gun logs get: TowPoint, Log;
-- Bird log get;
-- Sgy get.
>>
```

Figure 37. MatLab window with 'PR_Set' executed

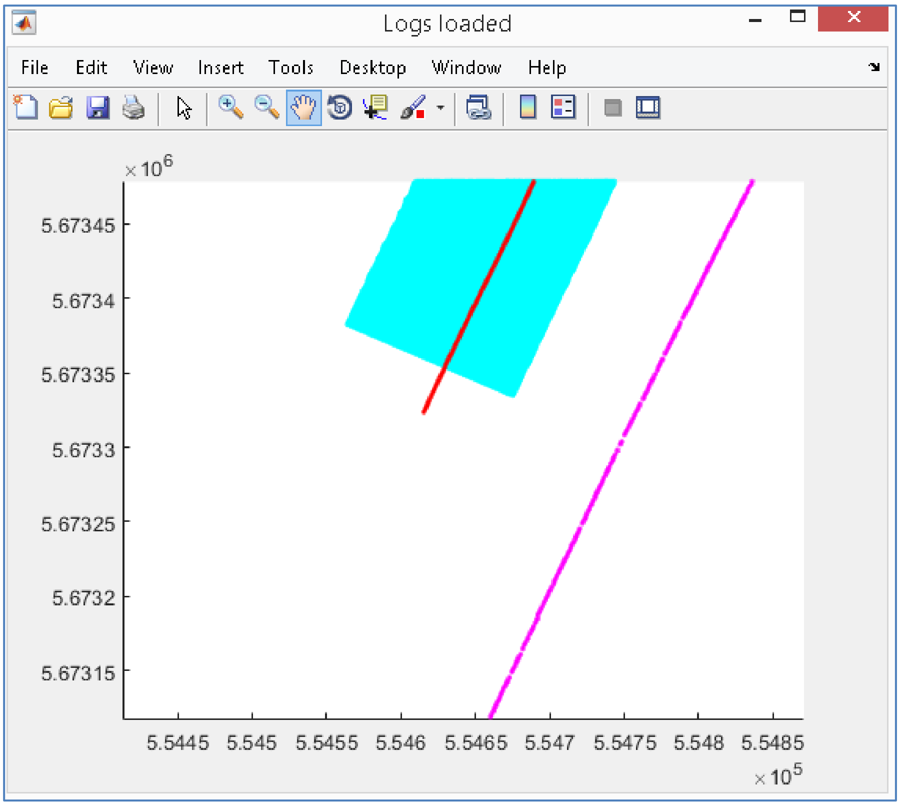


Figure 38. MatLab window with data loaded by 'PR_Set'

4.4.6 Fix&Shot_QC

{'Fix&Shot_QC',1};gUhrGeoEelGeomR02;

The command is used for visual control Fix and Shots (FFID) correlation. The command includes one mandatory parameter:

1 – RP-variable cell number for survey line controlled; the value must be scalar.

The command draws 6 figures.

The figure_1 (Figure 39) shown the seismic station ShotID numbers at horizontal axis. The vertical axis shows step between ShotID, it must be “one”.

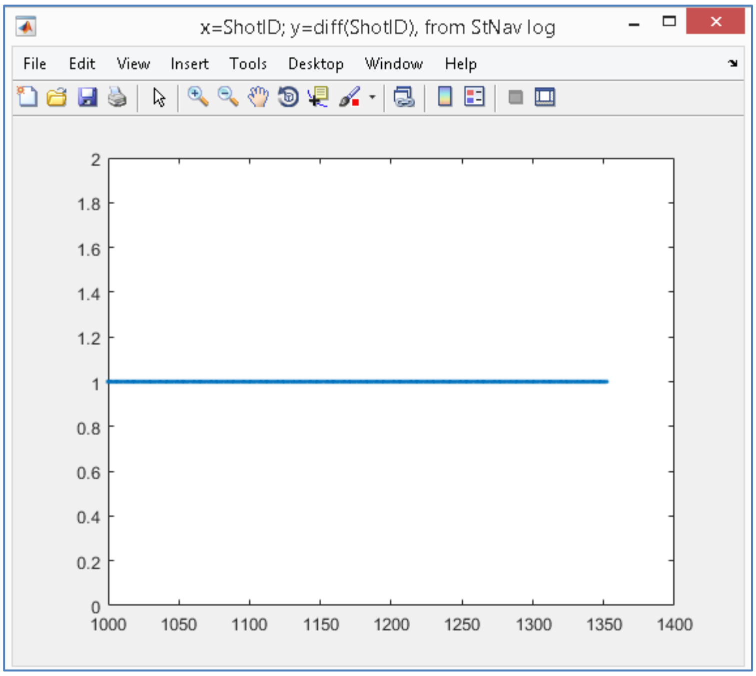


Figure 39. Station ShotID step “one”

The figure_2 (Figure 40) shown the seismic station ShotID numbers at horizontal axis. The vertical axis shows “time step” between shots. The time step is about 3 seconds, but two shots have time-step about 6 seconds. So, we assume that have two missed shots.

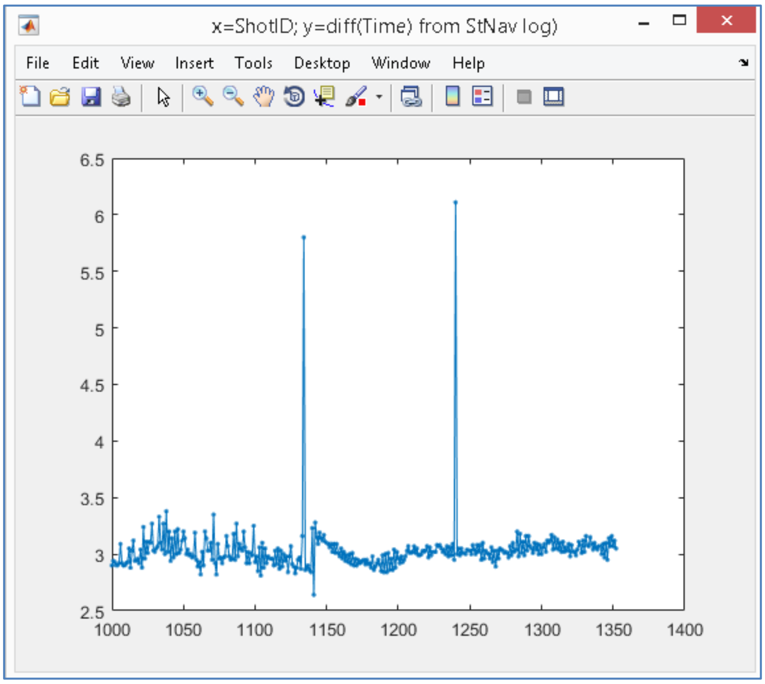


Figure 40. Station “time step” between shots

The figure_3 (Figure 41) shown the seismic station Fix numbers at horizontal axis (the shot points or pickets numbers sent from navigations with navigation message). In a first view, the Fix numbers the same than ShotID numbers.

The vertical axis shows step between Fix numbers, it must be “one”, but two Fix has the step “two”. So, we have two missed shots.

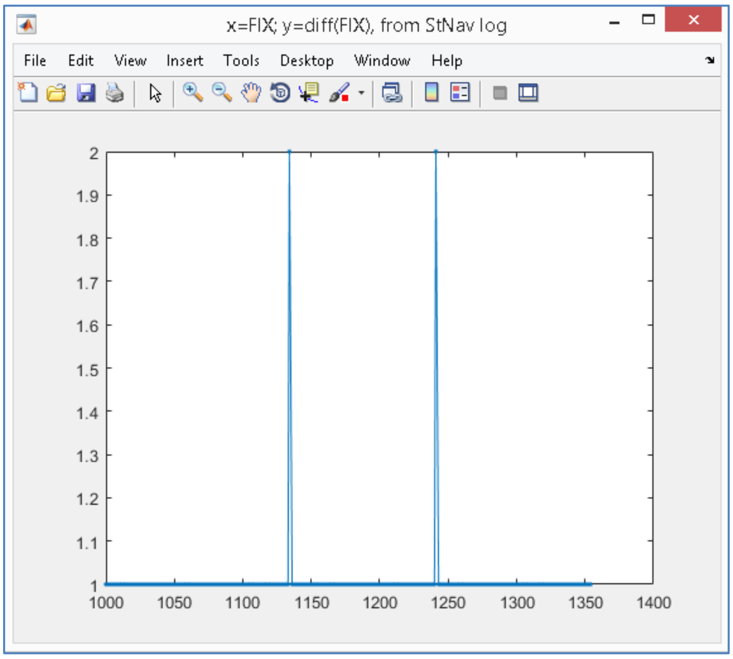


Figure 41. Station Fix step between shots

The figure_4 (Figure 42) shown the difference between Fix and ShotID. We can zoom “stair” and find missed Fix numbers. There are 1135 and 1242.

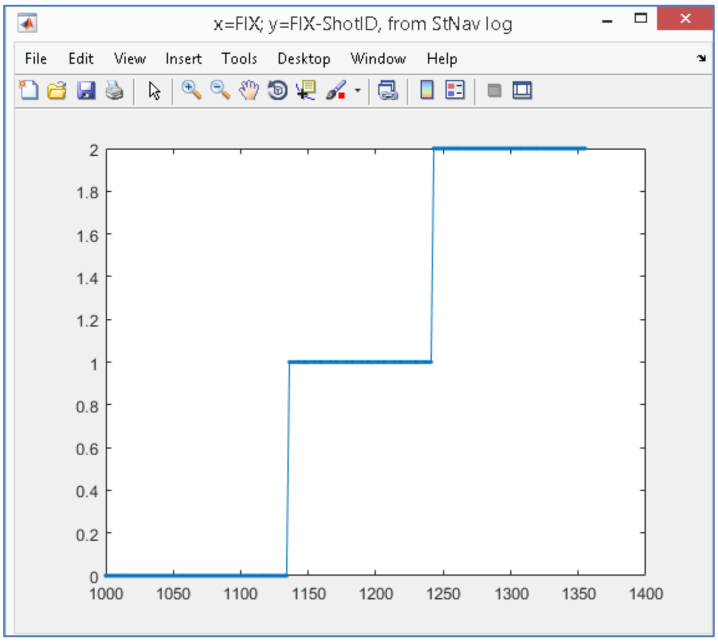


Figure 42. The difference between Fix and ShotID

The figure_5 (Figure 43) shown the GulLog ShotID numbers at horizontal axis. The vertical axis shows "time step" between shots by GunLog. The time step is about 3 seconds, but two shots have time-step about 6 seconds. This figure is the same figure_2, but used another equipment system.

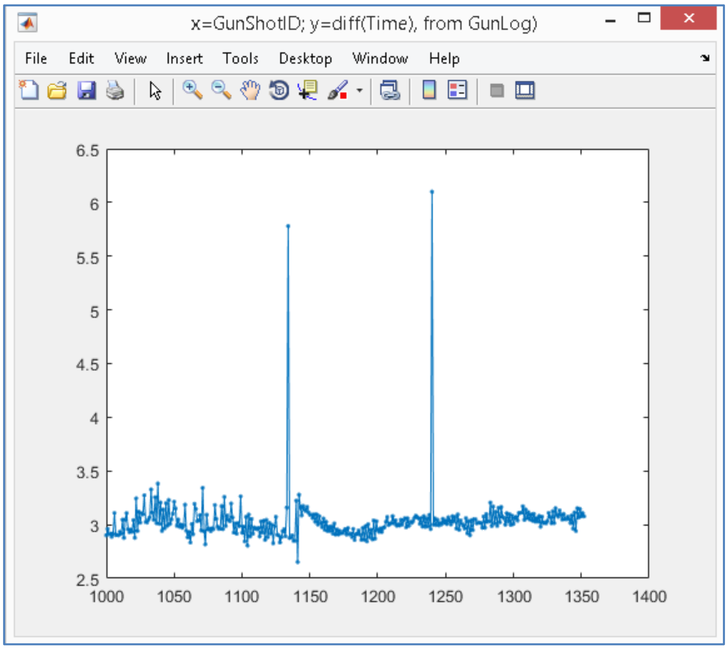


Figure 43. Guns "time step" between shots

The figure_6 (Figure 44) show difference between Qinsy "predicted" ShotTime and Gun "fixed" ShotTime. The both system used PPS-pulse for synchronization, but factually Guns make shot in ~25 millisecond later.

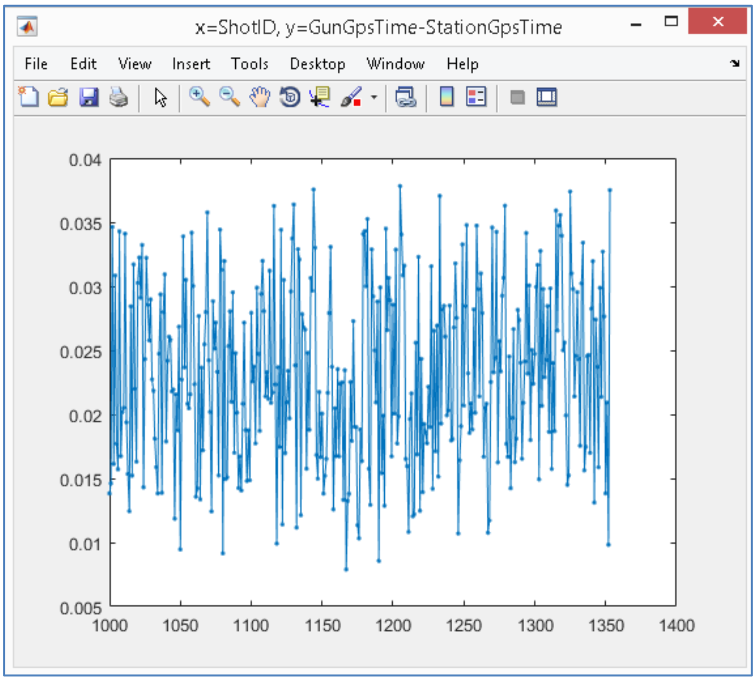


Figure 44. Difference between Qinsy "predicted" ShotTime and Gun "fixed" ShotTime

4.4.7 Time_QC

{'Time_QC','StTp','Gps',1,1:1};gUhrGeoEelGeomR02;

Spike control and smoothing for time; usually it applies to follow data fields: StTp, StBuoy, GunTp. **The 'Time_QC' mean that measurements time-period is same the constant.**

The command includes four mandatory parameters:

'StTp' – the data field for control and smoothing; usually 'StTp', 'StBuoy', 'GunTp';
'Gps' – the time-field prefix; usually 'Gps' or 'Comp';
1 – smooth window size;
1:1 – RP-variable cells number for data controlled.

The command includes two additional parameters:

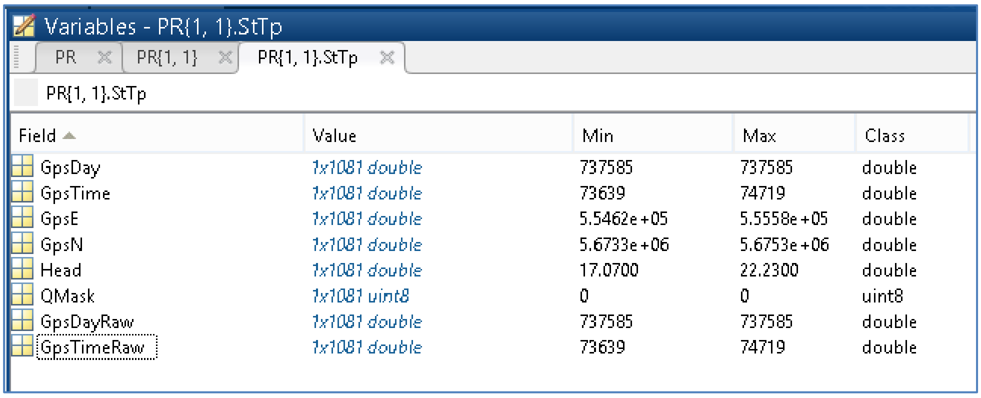
BitTQH – Select bit (value for "bitor" operation) for QC-mask; 1 by default;
flTQH – set flag for flag for mask's BitTQH reset; false by default.

When 'Time_QC' command executes first time than for target field creates "raw copy of corrected data" and QC-mask. For example, for command

{'Time_QC','StTp','Gps',1,1:1};gUhrGeoEelGeomR02;

will create tree fields (Figure 45):

QMask – the QC-mask (if field is not exist);
GpsDayRaw – the original GpsDay data;
GpsTimeRaw – the original GpsTime data.


Variables - PR{1, 1}.StTp
PR | PR{1, 1} | PR{1, 1}.StTp
PR{1, 1}.StTp

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
GpsE	1x1081 double	5.5462e+05	5.5558e+05	double
GpsN	1x1081 double	5.6733e+06	5.6753e+06	double
Head	1x1081 double	17.0700	22.2300	double
QMask	1x1081 uint8	0	0	uint8
GpsDayRaw	1x1081 double	737585	737585	double
GpsTimeRaw	1x1081 double	73639	74719	double

Figure 45. Additional fields created by 'Time_QC' command

The QC-mask bits are the 8 QC-flags which detect some "evidence". Usually the bit 0 is the "Manual corrected spikes for time" bit; bit 1 is the "Manual corrected spikes for coordinates" bit. But default Time-bit number can be changed using BitTQH.

When we execute 'Time_QC' command again (second or third time), the follow steps are made:

-- the smoothed data change to original data;
-- the delete all "previously marked points" in accordance with QC-mask's BitTQH.

To except "previously marked points" deleting we need set flag flTQH to true. This setting is reset BitTQH for QC-mask.

When 'Time_QC' command starts the two "QC interactive plots" will be drawn. These plots are used for "bad and spike points" delete (see Operations with QC interactive plots).

For the first plot the regular linear trend is removed from time-series. If the time step is constant, than plot will be horizontal; any changes in time-steps will draw as variation or spikes. The QC interactive plots in Figure 46 show a good time-regularity without time-step changes (the changes are about 10^{-10}); no spikes need to delete.

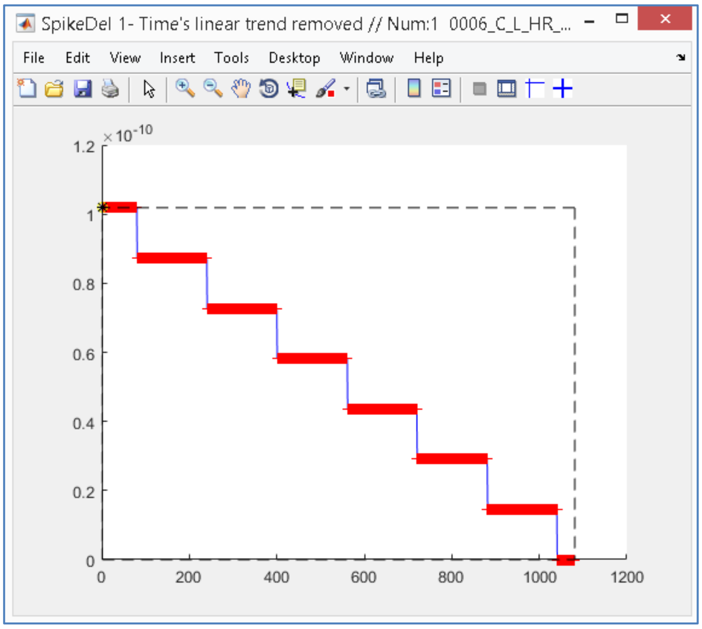


Figure 46. First step interactive 'Time_QC' – linear trend removed

For the second plot the difference between nearest time measurements is draw. If the time step is constant, than plot will be horizontal; any changes in time-steps will draw as variation or spikes. The QC interactive plots in Figure 47 show a good time-regularity.

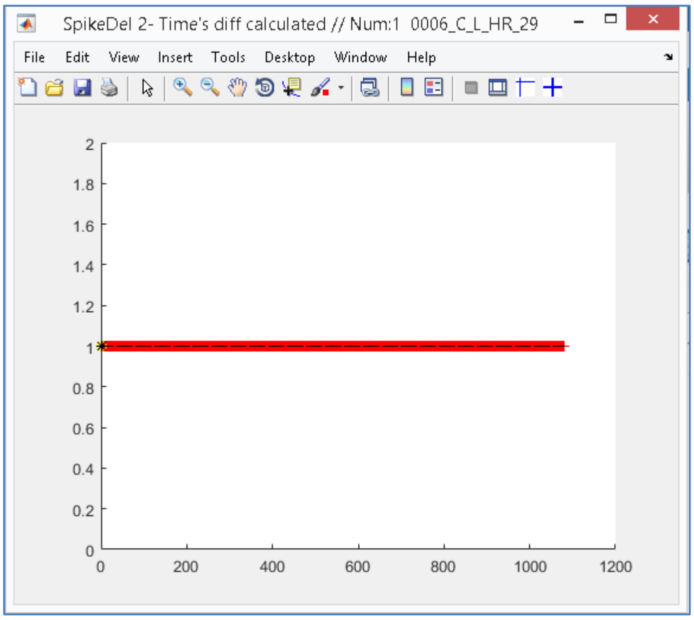


Figure 47. Second step interactive 'Time_QC' – diff calculated

The finally, plot with spikes removed and smoothed is draw to estimate 'Time_QC' result (Figure 48).

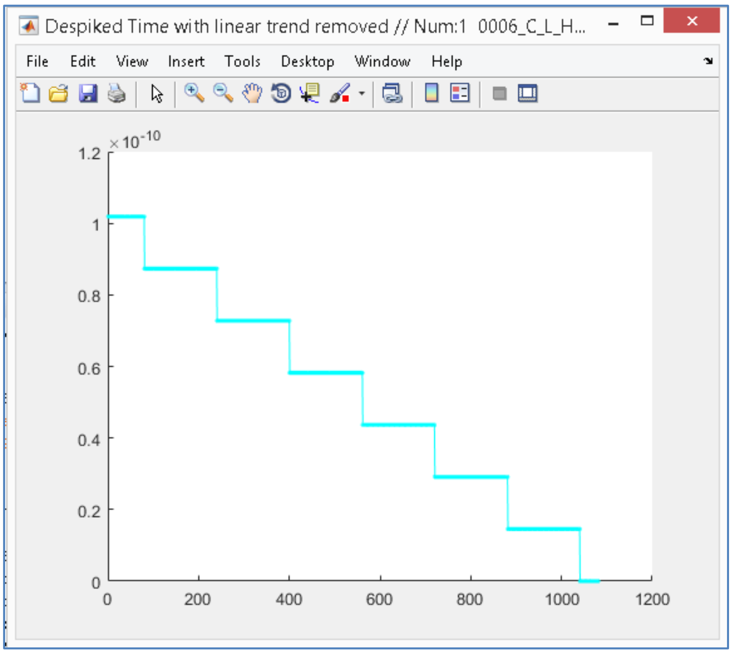


Figure 48. The 'Time_QC' result

4.4.8 Coord_QC

{'Coord_QC','StTp','Gps',10,1};gUhrGeoEelGeomR02;

Spike control and smoothing for coordinates; usually it applies to follow data fields: StTp, StBuoy, GunTp. **The 'Coord_QC' mean that coordinates changes for time-steps are same the constant.**

The command includes four mandatory parameters:

'StTp' – the data field for control and smoothing; usually 'StTp', 'StBuoy', 'GunTp';
'Gps' – the time-field prefix (used for delete spikes interpolation); usually 'Gps' or 'Comp';
10 – smooth window size;
1 – RP-variable cells number for data controlled.

The command includes two additional parameters:

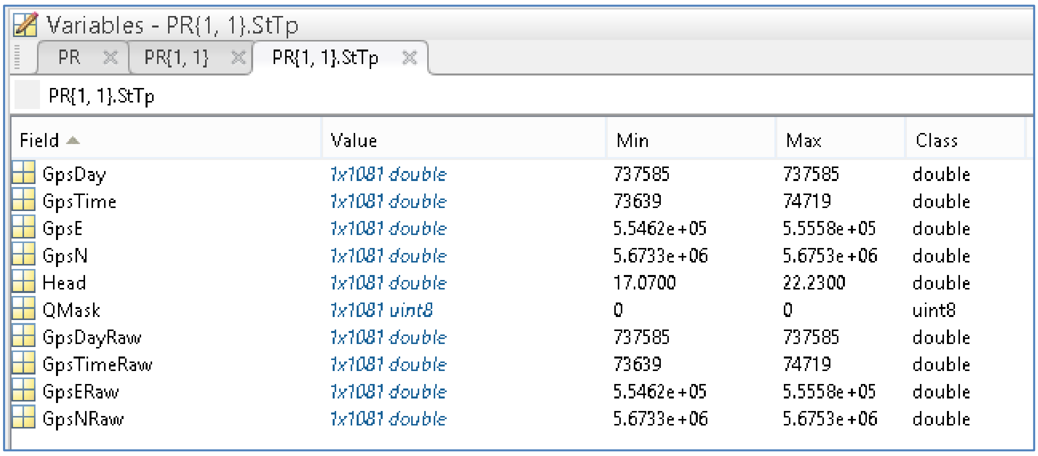
BitCQH – Select bit (value for “bitor” operation) for QC-mask; 2 by default;
flCQH – set flag for flag for mask’s BitCQH reset; false by default.

When 'Coord_QC' command executes first time than for target field creates “raw copy of corrected data” and QC-mask. For example, for command

{'Coord_QC','StTp','Gps',10,1:1};gUhrGeoEelGeomR02;

will create tree fields (Figure 49):

QMask – the QC-mask (if field is not exist);
GpsERaw – the original GpsDay data;
GpsNRaw – the original GpsTime data.



Variables - PR{1, 1}.StTp

PR | PR{1, 1} | PR{1, 1}.StTp

PR{1, 1}.StTp

Field	Value	Min	Max	Class
GpsDay	1x1081 double	737585	737585	double
GpsTime	1x1081 double	73639	74719	double
GpsE	1x1081 double	5.5462e+05	5.5558e+05	double
GpsN	1x1081 double	5.6733e+06	5.6753e+06	double
Head	1x1081 double	17.0700	22.2300	double
QMask	1x1081 uint8	0	0	uint8
GpsDayRaw	1x1081 double	737585	737585	double
GpsTimeRaw	1x1081 double	73639	74719	double
GpsERaw	1x1081 double	5.5462e+05	5.5558e+05	double
GpsNRaw	1x1081 double	5.6733e+06	5.6753e+06	double

Figure 49. Additional fields created by 'Coord_QC' command

The QC-mask bits are the 8 QC-flags which detect some “evidence”. Usually the bit 0 is the “Manual corrected spikes for time” bit; bit 1 is the “Manual corrected spikes for coordinates” bit. But default Coordinate-bit number can be changed using BitCQH.

When we execute 'Coord_QC' command again (second or third time), the follow steps are made:

-- the smoothed data change to original data;

-- the delete all “previously marked points” in accordance with QC-mask’s BitCQH.

To except “previously marked points” deleting we need set flag flCQH to true. This setting is reset BitTQH for QC-mask.

When 'Coord_QC' command starts the three “QC interactive plots” will be drawn. These plots are used for “bad and spike points” delete (see Operations with QC interactive plots).

For the first plot the track in EN-plane is draw (Figure 50); we can find and delete out-of-track plots.

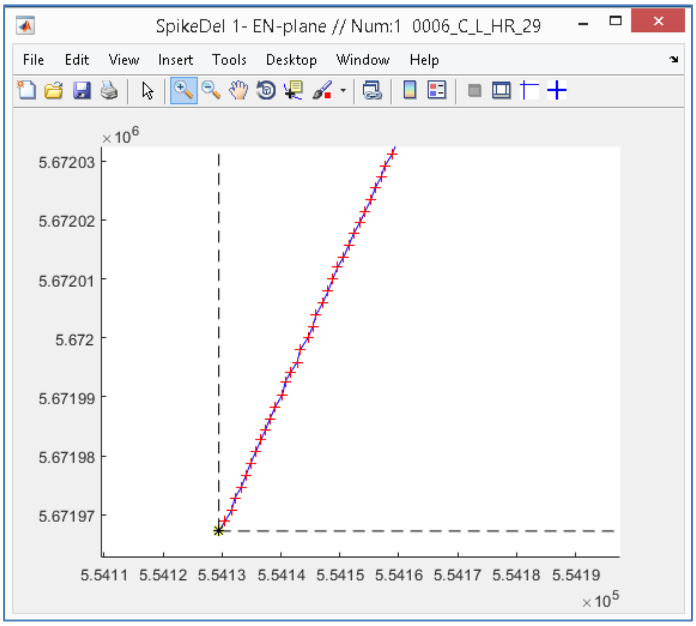


Figure 50. First step interactive 'Coord_QC' – linear trend removed

For the second plot, draw Easting coordinates along time-axis with the regular linear trend removed. If the speed is changed slowly, than Easting will drawn as a slowly changed curve. We see a number of spikes for Figure 51 that means instantaneous body movement. The measurements for those points can interpreted as un-correct and delete (Figure 52).

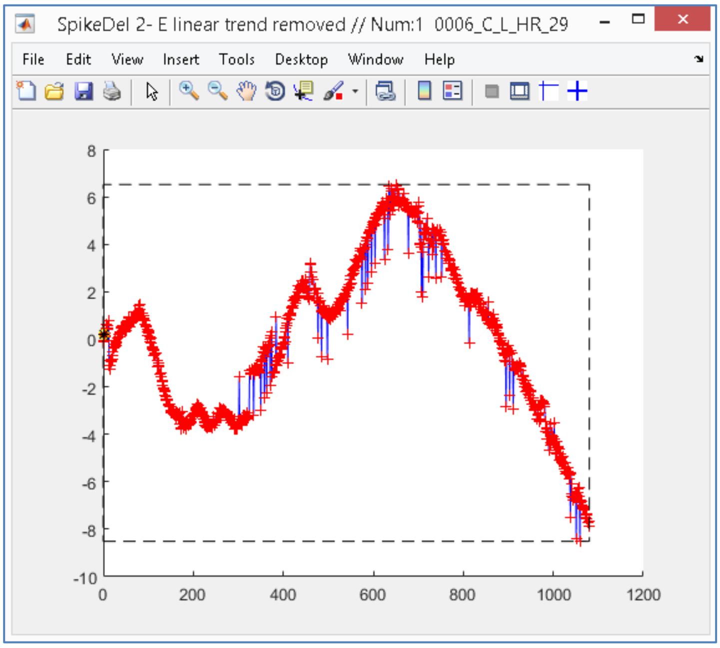


Figure 51. Second step interactive 'Coord_QC' – Easting linear trend removed

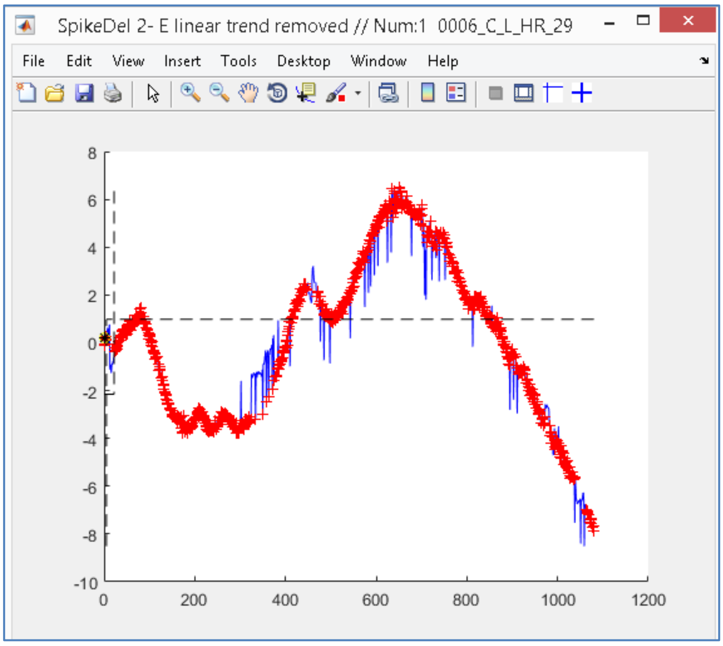


Figure 52. Second step interactive 'Coord_QC' with points deleted

For the third plot, draw Northing coordinates along time-axis with the regular linear trend removed. If the speed is changed slowly, than Northing will drawn as a slowly changed curve. The points were deleted for previous steps are not draw (Figure 53).

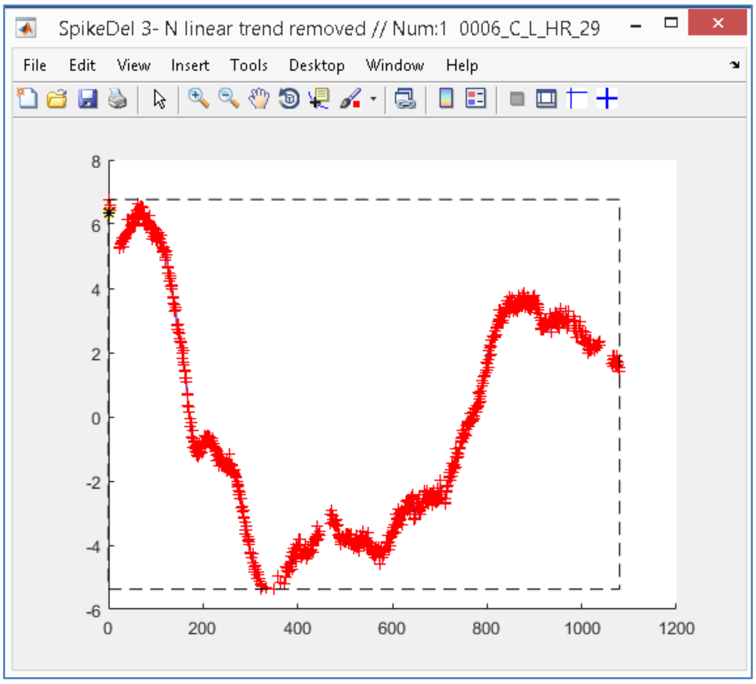


Figure 53. Third step interactive 'Coord_QC' – Northing linear trend removed

The plot with spikes removed is draw to estimate 'Coord_QC' result (Figure 54); the red points are a raw-data, the blue points are “acceptable” data (without smooth or interpolation).

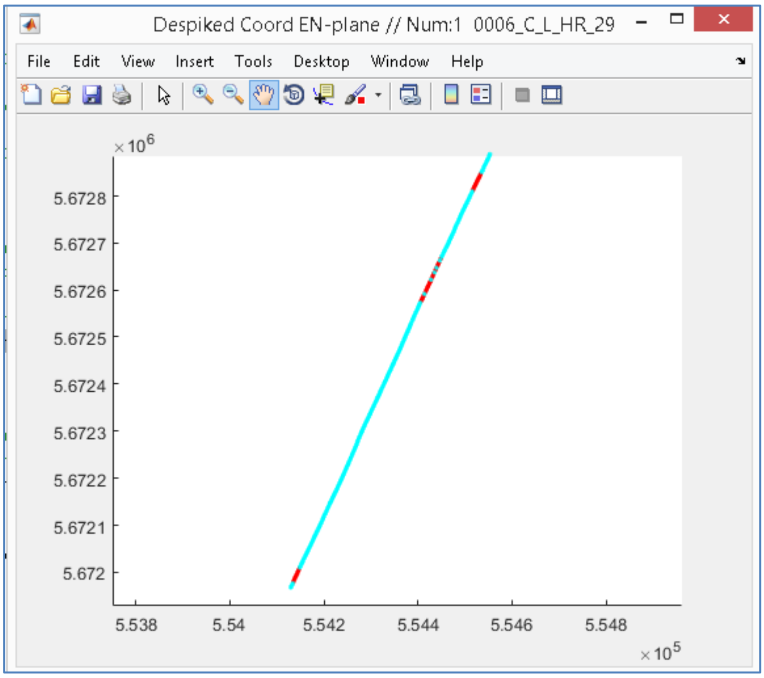


Figure 54. The 'Coord_QC' result with spikes removed (zoom in)

The finally, plot with spikes removed and smoothed is drawn (Figure 55); the red points are a raw-data, the blue points are the “acceptable” data was smoothed and interpolated to “deleted” points time.

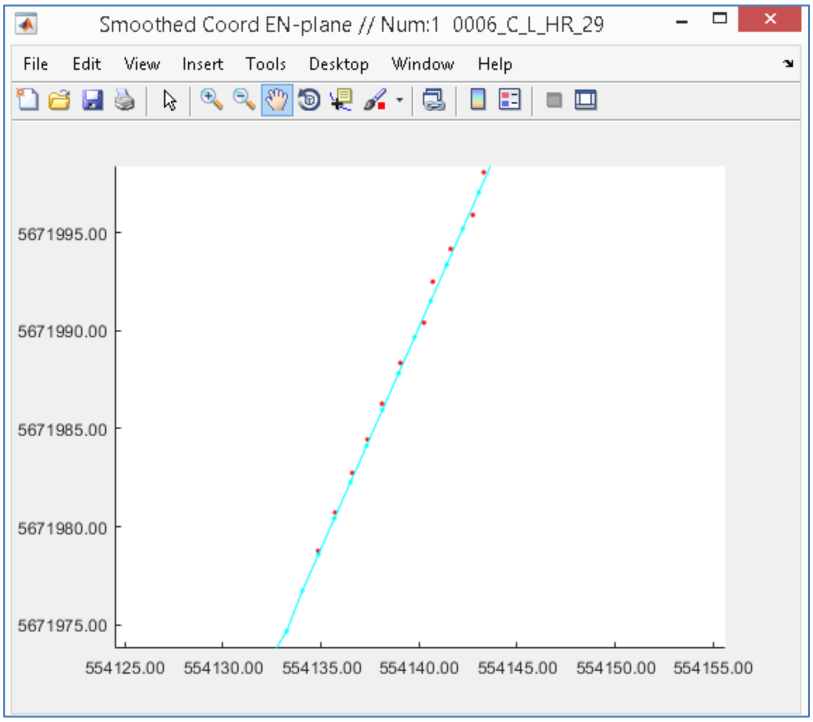
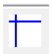


Figure 55. The 'Coord_QC' result with spikes removed and smooth (zoom in)

4.4.9 Operations with QC interactive plots

The “QC interactive plots” based on gMapPickHandleNan function of ge0mlib library. There are two points delete mode:

1) Rectangle (button  at the panel) – the mode set to nan all points data in selected rectangle (Figure 56);

2) Curve-section (button  at the panel) – the mode set to nan all points data for selected curve's part (Figure 57). The marked point for curve is detected using minimal distance from mouse-click; the distance is calculated for current axis-visual-scale. The first marker must be set in the start-of-plot side.

The follow button can use:

LeftMouseButton – first selection element (first part of rectangle or first point at curve);
RightMouseButton – second selection element (second part of rectangle or second point at curve);
MiddleMouseButton – set to NaN point’s data in selected area;
z – undo delete;
x – redo delete;
q – exit from mode 1 or 2.

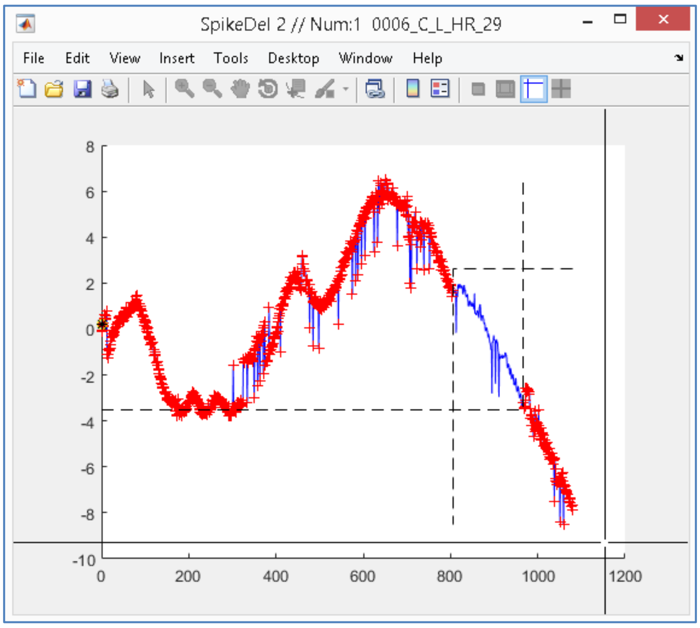


Figure 56. Mode 1 for point deletes (dotted rectangle)

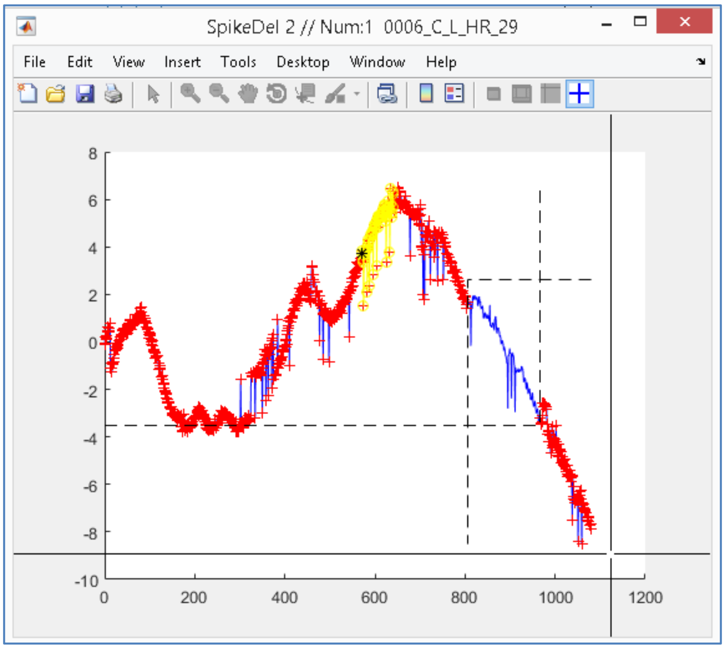


Figure 57. Mode 2 for point deletes (yellow color markers)

4.4.10 PR_CreateSet

{'PR_CreateSet',1};gUhrGeoEelGeomR02;

Interpolate survey line data from PR{...} variable to Fix time and calculate additional parameters (streamer feather angle, receivers' depth and coordinates, etc.). The results of calculation and interpolation are write to PR{...}.Z field. The command includes one mandatory parameter:

1 – RP-variable cells number for data synchronized.

The PR{...}.Z includes follow fields (see PR{n}.Z – field with synchronized data): ShotID, Fix, GpsDay, GpsTime, VessHead –

shot points' ID and time;

GunTpGpsE, GunTpGpsN, GunGpsE, GunGpsN, GunDepth, GunSeaDepth, dTGun, Manifold, Atmosferic, GunVolume –

cluster position and guns characteristics;

StTpGpsE, StTpGpsN, StBuoyGpsE, StBuoyGpsN, StHead, StTens, StRDepth –

streamer&buoys position and streamer characteristics;

StChGpsE(1..n), StChGpsN(1..n), StChDepth(1..n), StChSeaDepth(1..n), StGun2Ch(1..n) –

streamer's channels position;

Cmp1GpsE, Cmp1GpsN –

CMP1 position;

BirdGpsE(1..m), BirdGpsN(1..m), BirdDepth(1..m), BirdHead(1..m), BirdAngle(1..m), BirdTemper(1..m) –

streamer's birds position and characteristics.

The created to PR{1}.Z data is shown in Figure 58 and Figure 59. The cyan points is the MBES data (points of depth measurements); the red points is seismic cluster towpoint for Fix time (the red vectors show the vessel's heading); the blue line is streamer towpoint for Fix time; the magenta line is tailbuoy position for Fix time. The additional thin blue lines are the seismic birds' position; the green lines are the seismic channels position.

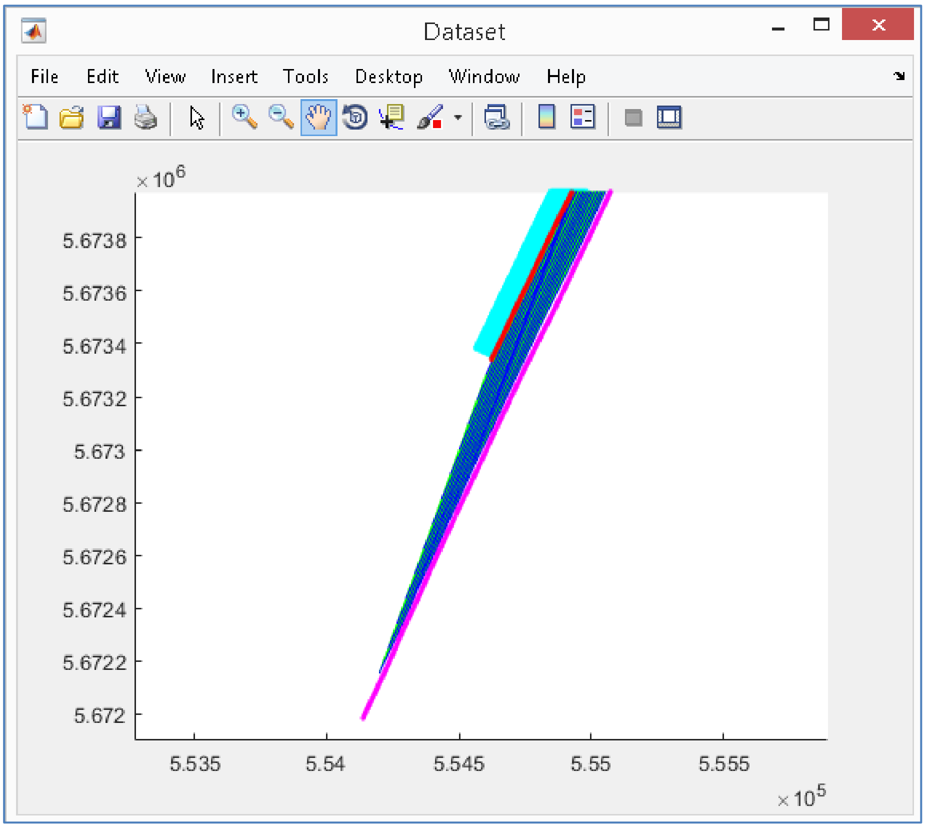


Figure 58. MatLab window with data created by 'PR_CreateSet'

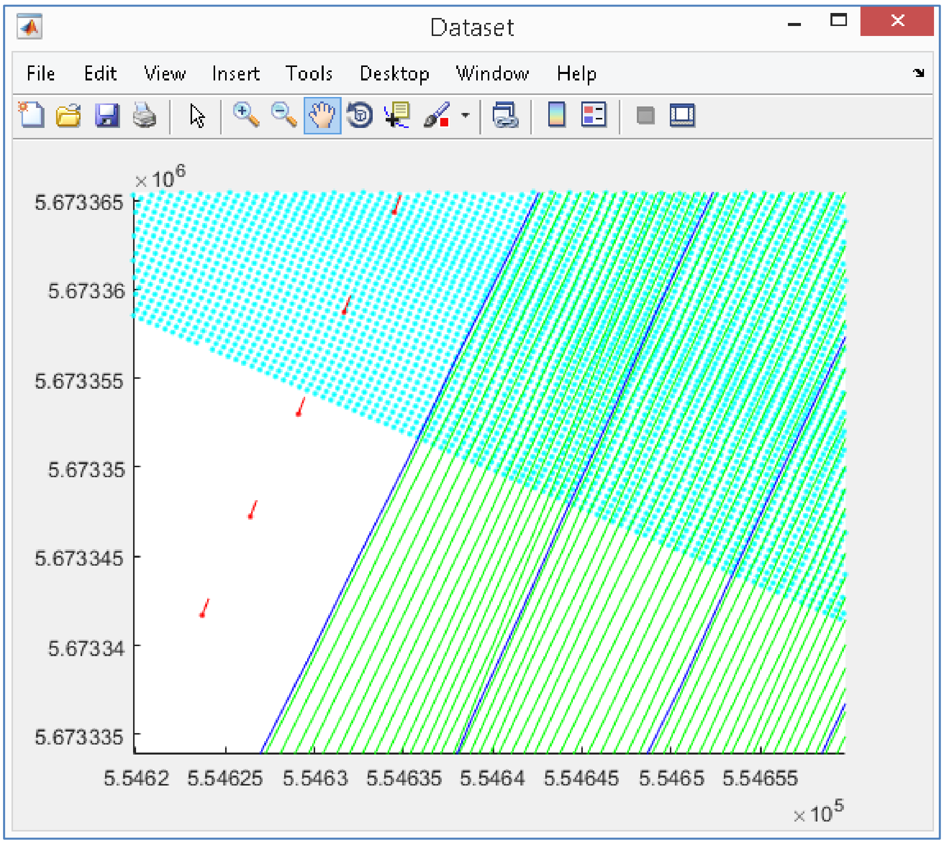


Figure 59. MatLab window with data created by 'PR_CreateSet' (zoomed)

4.4.11 OutPromaxGunGeom

{'OutPromaxGunGeom',1};gUhrGeoEelGeomR02;

Export synchronized data from PR{...}.Z field to output file with "2D Marine geometry spreadsheet for ProMax" (see "ProMax source geometry spreadsheet").

The command includes one mandatory parameter:

1 – RP-variable cells number for data synchronized.

The command includes two additional parameters:

SrcPattern0 – Src Pattern is the source pattern number corresponding to values in the Src Pattern column in the Patterns spreadsheet. Source patterns are defined in the Patterns spreadsheet. SrcPattern0=1 by default.

Static0 – Static is a user defined static in ms. If pre-existing shot statics are going to be applied to a dataset, they can be entered in this column. For example, shot time delays due to time break errors during recording could be entered in this column. These statics can later be applied with Apply User Statics. Static0=0 by default.

The command can be write as: {'OutPromaxGunGeom',1,4,0};gUhrGeoEelGeomR02;

4.4.12 OutP190Geom

{'OutP190Geom','Gun',2018,1,10,'S'};gUhrGeoEelGeomR02;

Export synchronized data from PR{...}.Z field to three files:

-- P1/90 file (see P1/90 and AutoCad scripts),

-- AutoCad's script file (see P1/90 and AutoCad scripts),

-- Catalogue file (see Catalogue file).

The command includes four mandatory parameters:

'Gun' – exported Coordinates Field Prefix; usually 'Gun' or 'Cmp1';

2018 – year of survey;

1 – RP-variable cells number for data exporting (for example: 1 or 1:5 or [1 3 5 2]).

The command includes eight additional parameters:

CatStep – the points step for catalogue file. Set to 1 by default;

RecordId – for P1/90; Char; Record identification (COL1; A1): 'S'=Centre of Source; 'G'=Receiver Group; 'Q'=Bin Centre; 'A'=Antenna Position; 'T'=Tailbuoy Position; 'C'=Common Mid Point; 'V'=Vessel Reference Point; 'E'=Echo Sounder; 'Z'=Other, defined in H0800. Set to 'S' by default. Usually set to 'S' or 'C'.

Spare1 – for P1/90; 3 Chars; Spare (COL14-16 A3); if nonexist, then create values '   '. Set to '...' by default (3 spaces).

VesselId – for P1/90; Char; Vessel ID (COL17 A1). Set to '1' by default.

SourceId – for P1/90; Char; Source ID (COL18 A1). Set to '1' by default.

OtherId – for P1/90; Char; Tailbuoy / Other ID (COL19 A1). Set to '1' by default.

Spare2 – for P1/90; Char; Spare (COL80 1X); if nonexist, then create values ' '. Set to ' ' by default (1 space).

WCode – for P1/90; metric flag for GpsLat, GpsLon, GpsE, GpsN, WaterDepth; symbols "M" (metric) or "N" (non metric) are used. Example: 'NNMMM' - Lat and Lon will saved in d.m.s.

4.4.13 OutSgyGeom

{'OutSgyGeom',1};gUhrGeoEelGeomR02;

Export synchronized data from PR{...}.Z field to Sgy-fields (Text header, Binary Header, Traces Headers) and save it to output Sgy-file with nav-merged data.

The command includes one mandatory parameter:

1 – RP-variable cells for data export.

The commands code includes three sections:

1) for Sgy Textural Header Correction (see Text-header);

2) for Sgy Binary Headers Correction (see Binary-header);

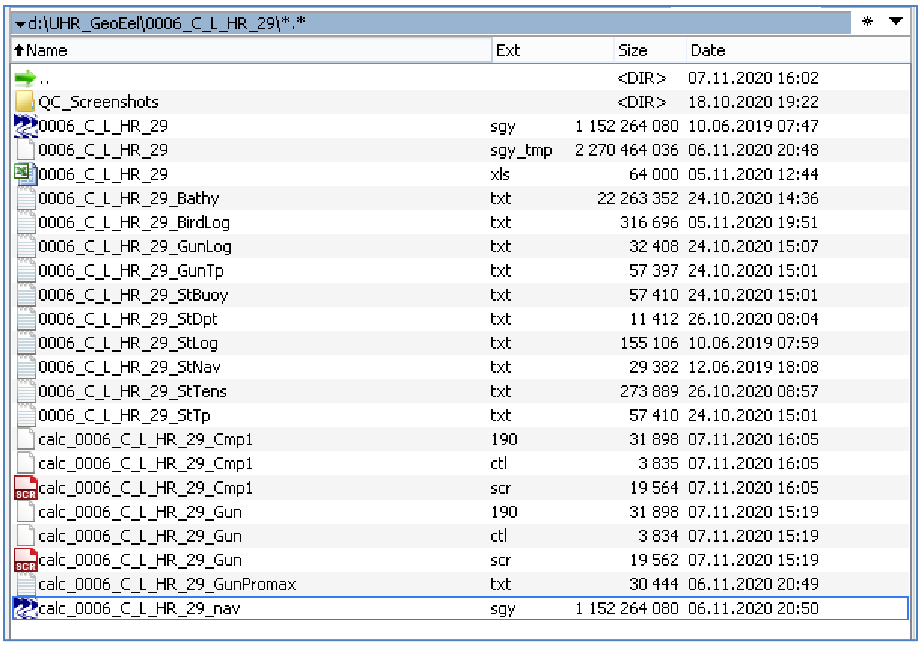
3) for Sgy Trace Headers Correction (see Trace-headers).

Each section code can be changed to apply new features to Sgy-fields data. For example the new auto-update text can be added to Sgy Textural Header.

5 Output files

The script's work result is the number of files with geometry calculated (Figure 60). There are:

-- calc_....._Cmp1.190 – the file contained P1/90 for first channel's CMP1-point;
-- calc_...._Cmp1.scr – the file contained AutoCad script, which drawing CMP1-trackplot;
-- calc_...._Cmp1.ctl – the file contained coordinates catalogue for CMP1;
-- calc_...._Gun.190 – the file contained P1/90 for seismic cluster position point;
-- calc_...._Gun.scr – the file contained AutoCad script, which drawing Gun-trackplot;
-- calc_...._Gun.ctl – the file contained coordinates catalogue for Gun;
-- calc_...._GunPromax.txt – the file contained spreadsheet for ProMax "2D Marine Geometry Assignment" procedure;
-- calc_...._nav.sgy – the Sgy-file merged with navigation.


d:\UHR_GeoEel\0006_C_L_HR_29*.*

Name	Ext	Size	Date
..		<DIR>	07.11.2020 16:02
QC_Screenshots		<DIR>	18.10.2020 19:22
0006_C_L_HR_29	sgy	1 152 264 080	10.06.2019 07:47
0006_C_L_HR_29	sgy_tmp	2 270 464 036	06.11.2020 20:48
0006_C_L_HR_29	xls	64 000	05.11.2020 12:44
0006_C_L_HR_29_Bathy	txt	22 263 352	24.10.2020 14:36
0006_C_L_HR_29_BirdLog	txt	316 696	05.11.2020 19:51
0006_C_L_HR_29_GunLog	txt	32 408	24.10.2020 15:07
0006_C_L_HR_29_GunTp	txt	57 397	24.10.2020 15:01
0006_C_L_HR_29_StBuoy	txt	57 410	24.10.2020 15:01
0006_C_L_HR_29_StDpt	txt	11 412	26.10.2020 08:04
0006_C_L_HR_29_StLog	txt	155 106	10.06.2019 07:59
0006_C_L_HR_29_StNav	txt	29 382	12.06.2019 18:08
0006_C_L_HR_29_StTens	txt	273 889	26.10.2020 08:57
0006_C_L_HR_29_StTp	txt	57 410	24.10.2020 15:01
calc_0006_C_L_HR_29_Cmp1	190	31 898	07.11.2020 16:05
calc_0006_C_L_HR_29_Cmp1	ctl	3 835	07.11.2020 16:05
calc_0006_C_L_HR_29_Cmp1	scr	19 564	07.11.2020 16:05
calc_0006_C_L_HR_29_Gun	190	31 898	07.11.2020 15:19
calc_0006_C_L_HR_29_Gun	ctl	3 834	07.11.2020 15:19
calc_0006_C_L_HR_29_Gun	scr	19 562	07.11.2020 15:19
calc_0006_C_L_HR_29_GunPromax	txt	30 444	06.11.2020 20:49
calc_0006_C_L_HR_29_nav	sgy	1 152 264 080	06.11.2020 20:50

Figure 60. The sub-folder content example – input and output data

5.1 P1/90 and AutoCad scripts

The *.190 files is U.K.O.O.A. P1/90 files. It based on IOGP document: "U.K.O.O.A. P1/90 post plot data exchange tape 1990 format, 28 June 1990". The file's Record's Type is 1 "Grid or geographical coordinates", without Item 16 (RecordId='R': Receiver group records for 3-D offshore surveys).

Files formed using template txt-file with Header, located in the root-folder of data. The file example is shown in Figure 61. The symbols marked as ### are automatically changed for file will created, using actual data.

The calc_....._Cmp1.190 file example shown in Figure 62.

Lister - [d:\UHR_GeoEel\P190_Cmp1Header.txt]

File Edit Options Encoding Help 100 %

```
H0100Survey area .............. 54NN (Malma; Deryugin; Sakhalin Island)
H0101Job description .......... 2D HR, 1 streamer, 1 source
H0102Vessel details ........... Ivan Kireev                          1
H0103Source details ........... 1xSERCEL G.GUN 150cu - M 9/16 JIC      1 1
H0104Streamer details ......... GeoEel (solid, 192 channels)         1   1
H0105TailBuoy ................. SeaMap Buoylink EX                   1     1
H0200Survey date .............. 06 November 2020
H0201Tape date ................ ###
H0202Tape version ............. UKOOA P1/90
H0203Line prefix .............. S20AF
H0300Client ................... ExxonMobil
H0400Geophysical contractor ... ROMONA
H0500Positioning contractor ... ROMONA
H0600Pos. proc. contractor .... GEOGALS
H0700Positioning system ....... Veripos LD3S
H0800Shotpoint position ....... CMP Channel 1
H1000Clock time relative GMT... GMT 0.0 hours
H1100Number of rec. groups .... 192
H1400Geodetic Datum Survey .... WGS-84   WGS-84   6378137.000   298.2572235630
H1401Transformation to WGS84 ..   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1500Geodetic Datum Postplot .. WGS-84   WGS-84   6378137.000   298.2572235630
H1501Transformation to WGS84 ..   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1600Datums Transformation ....   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1700Vertical datum ........... LAT
H1800Projection type .......... 001UTM  Nothern hemisphere
H1900Projection zone .......... 54 N
H2000Grid unit ................ 1Metres               1.000000
H2001Height unit .............. 1Metres               1.000000
H2002Angular unit ............. 1Degrees
H2200Central Meridian ......... 141  00  00.000E
H2301Grid Origin ..............   0  00  00.000N  141  00  00.000E
H2302Grid coord. at Origin .... 500000.00E  0.00N
H2401Scale factor ............. 0.9996
H2402Lat/Lon at wich scale def.   0  00  00.000N  141  00  00.000E
H2600Water depth .............. Current sea surface by Echo Sounder
```

Figure 61. P1/90 Header template for CMP1 position

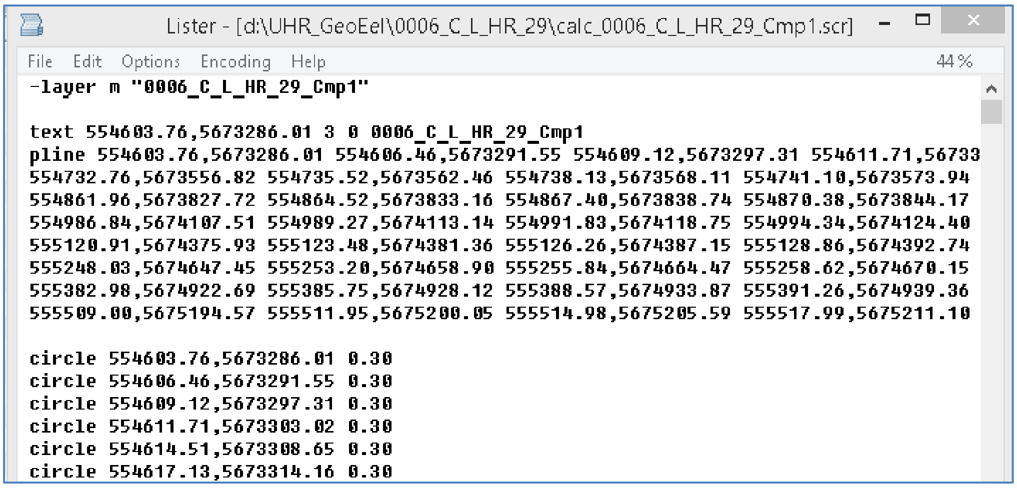
Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\calc_0006_C_L_HR_29_Cmp1.190]

File Edit Options Encoding Help 12 %

```
H0100Survey area .............. 54NN (Malma; Deryugin; Sakhalin Island)
H0101Job description .......... 2D HR, 1 streamer, 1 source
H0102Vessel details ........... Ivan Kireev                          1
H0103Source details ........... 1xSERCEL G.GUN 150cu - M 9/16 JIC      1 1
H0104Streamer details ......... GeoEel (solid, 192 channels)         1   1
H0105TailBuoy ................. SeaMap Buoylink EX                   1     1
H0200Survey date .............. 06 November 2020
H0201Tape date ................ 09 June 2019
H0202Tape version ............. UKOOA P1/90
H0203Line prefix .............. S20AF
H0300Client ................... ExxonMobil
H0400Geophysical contractor ... ROMONA
H0500Positioning contractor ... ROMONA
H0600Pos. proc. contractor .... GEOGALS
H0700Positioning system ....... Veripos LD3S
H0800Shotpoint position ....... CMP Channel 1
H1000Clock time relative GMT... GMT 0.0 hours
H1100Number of rec. groups .... 192
H1400Geodetic Datum Survey .... WGS-84   WGS-84   6378137.000   298.2572235630
H1401Transformation to WGS84 ..   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1500Geodetic Datum Postplot .. WGS-84   WGS-84   6378137.000   298.2572235630
H1501Transformation to WGS84 ..   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1600Datums Transformation ....   0.0    0.0    0.0 0.000 0.000 0.000 0.0000000
H1700Vertical datum ........... LAT
H1800Projection type .......... 001UTM  Nothern hemisphere
H1900Projection zone .......... 54 N
H2000Grid unit ................ 1Metres               1.000000
H2001Height unit .............. 1Metres               1.000000
H2002Angular unit ............. 1Degrees
H2200Central Meridian ......... 141  00  00.000E
H2301Grid Origin ..............   0  00  00.000N  141  00  00.000E
H2302Grid coord. at Origin .... 500000.00E  0.00N
H2401Scale factor ............. 0.9996
H2402Lat/Lon at wich scale def.   0  00  00.000N  141  00  00.000E
H2600Water depth .............. Current sea surface by Echo Sounder
C0006_C_L_HR_    111  1000511230.09N1414654.05E 554603.85673286.0  43.6160202728
C0006_C_L_HR_    111  1001511230.27N1414654.19E 554606.55673291.5  43.6160202731
C0006_C_L_HR_    111  1002511230.46N1414654.33E 554609.15673297.3  43.6160202734
C0006_C_L_HR_    111  1003511230.64N1414654.47E 554611.75673303.0  43.6160202737
C0006_C_L_HR_    111  1004511230.82N1414654.61E 554614.55673308.6  43.6160202740
C0006_C_L_HR_    111  1005511231.00N1414654.75E 554617.15673314.2  43.6160202743
C0006_C_L_HR_    111  1006511231.18N1414654.89E 554619.85673319.8  43.6160202746
C0006_C_L_HR_    111  1007511231.38N1414655.04E 554622.75673325.8  43.6160202749
```

Figure 62. Example of P1/90 files with CMP position

The AutoCad script (calc_...._Cmp1.scr) text example is shown in Figure 63. The script drop to AutoCad window; it create separate layer with Survey line name and draw trackplot (Figure 64). The “Snap cursor” in AutoCad must be off for processing correctly.



Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\calc_0006_C_L_HR_29_Cmp1.scr]

File Edit Options Encoding Help 44 %

```
-layer m "0006_C_L_HR_29_Cmp1"

text 554603.76,5673286.01 3 0 0006_C_L_HR_29_Cmp1
pline 554603.76,5673286.01 554606.46,5673291.55 554609.12,5673297.31 554611.71,56733
554732.76,5673556.82 554735.52,5673562.46 554738.13,5673568.11 554741.10,5673573.94
554861.96,5673827.72 554864.52,5673833.16 554867.40,5673838.74 554870.38,5673844.17
554986.84,5674107.51 554989.27,5674113.14 554991.83,5674118.75 554994.34,5674124.40
555120.91,5674375.93 555123.48,5674381.36 555126.26,5674387.15 555128.86,5674392.74
555248.03,5674647.45 555253.20,5674658.90 555255.84,5674664.47 555258.62,5674670.15
555382.98,5674922.69 555385.75,5674928.12 555388.57,5674933.87 555391.26,5674939.36
555509.00,5675194.57 555511.95,5675200.05 555514.98,5675205.59 555517.99,5675211.10

circle 554603.76,5673286.01 0.30
circle 554606.46,5673291.55 0.30
circle 554609.12,5673297.31 0.30
circle 554611.71,5673303.02 0.30
circle 554614.51,5673308.65 0.30
circle 554617.13,5673314.16 0.30
```

Figure 63. The AutoCad script text example

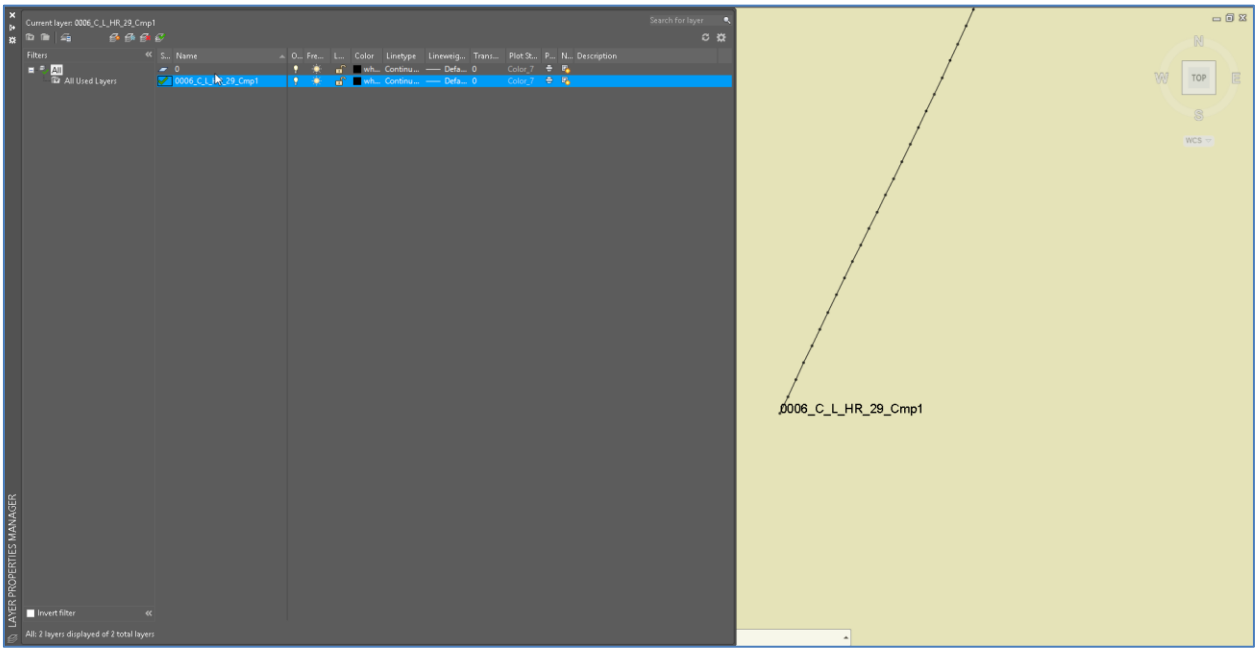


Figure 64. The AutoCad scripts processing result

There are follow data-columns contained in the P1/90 Type 1 (site from format description document):

HType – Record Identifier 'H' + Header Record Type + Header Record Type Modifier (A1+I2+I2);

HDescript – Parameter Description (A27);

HData – Parameter Data (A48);

RecordId – Char; Record identification (COL1; A1): 'S'=Centre of Source; 'G'=Receiver Group; 'Q'=Bin Centre; 'A'=Antenna Position; 'T'=Tailbuoy Position; 'C'=Common Mid Point; 'V'=Vessel Reference Point; 'E'=Echo Sounder; 'Z'=Other, defined in H0800.

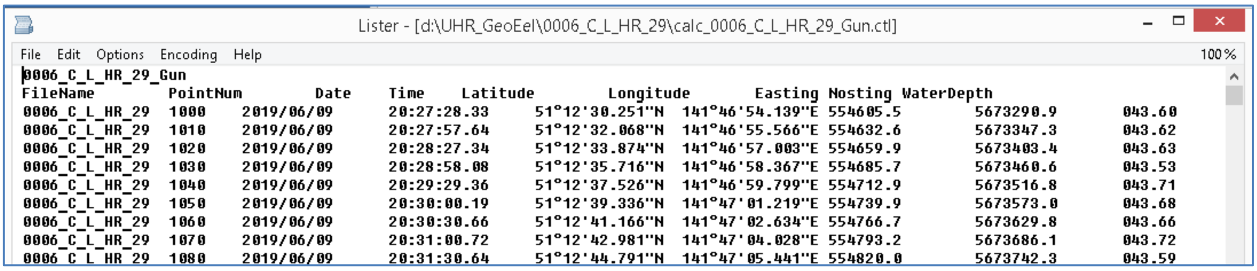
LineName – Char; Line name (left justified, including reshoot code) (COL2-13 A12);

Spare1 – Char; Spare (COL14-16 A3); if non-exist, then create values '   ';

VesselId – Char; Vessel ID (COL17 A1);
SourceId – Char; Source ID (COL18 A1);
OtherId – Char; Tailbuoy / Other ID (COL19 A1);
PointNum – Float; Point number (right justified) (COL20-25 A6); if non-exist, then create values from 1 to N;
GpsLat – Float; Latitude in d.m.s. N/S (COL26-35 2(I2), F5.2, A1) or in grads N/S (COL26-35 F9.6, A1);
GpsLon – Float; Longitude in d.m.s. E/W (COL36-46 I3, I2, F5.2, A1) or in grads E/W (COL36-46 F10.6, A1);
GpsE – Float; Map grid Easting in metres (COL47-55 F9.1) or in non-metric (COL47-55 I9);
GpsN – Float; Map grid Northing in metres (COL56-64 F9.1) or in non-metric (COL56-64 I9);
WaterDepth – Float; Water depth defined datum defined in H1700 (COL65-70 F6.1) or elevation in non-metric (COL65-70 I6); if non-exist, then create values ' 0.0';
GpsDay – Float; Date (date number 1 corresponds to Jan-1-000; the year 0000 is merely a reference point); calculated using Julian Day of year (COL71-73 I3);
GpsTime – Float; Second in day; calculated using time h.m.s., GMT or as stated in H1000 (COL74-79 3I2);
Spare2 – Char; Spare (COL80 1X); if non-exist, then create values ' '.

5.2 Catalogue file

The file contained data, same the P1/90 for “coordinate’s catalogue” with defined point step. The first and last points get from data for any step. The example of file is shown in Figure 65.


Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\calc_0006_C_L_HR_29_Gun.ctl]
File Edit Options Encoding Help 100 %

0006_C_L_HR_29_Gun

FileName	PointNum	Date	Time	Latitude	Longitude	Easting	Nosting	WaterDepth
0006_C_L_HR_29	1000	2019/06/09	20:27:28.33	51°12'30.251"N	141°46'54.139"E	554605.5	5673290.9	043.60
0006_C_L_HR_29	1010	2019/06/09	20:27:57.64	51°12'32.068"N	141°46'55.566"E	554632.6	5673347.3	043.62
0006_C_L_HR_29	1020	2019/06/09	20:28:27.34	51°12'33.874"N	141°46'57.003"E	554659.9	5673403.4	043.63
0006_C_L_HR_29	1030	2019/06/09	20:28:58.08	51°12'35.716"N	141°46'58.367"E	554685.7	5673460.6	043.53
0006_C_L_HR_29	1040	2019/06/09	20:29:29.36	51°12'37.526"N	141°46'59.799"E	554712.9	5673516.8	043.71
0006_C_L_HR_29	1050	2019/06/09	20:30:00.19	51°12'39.336"N	141°47'01.219"E	554739.9	5673573.0	043.68
0006_C_L_HR_29	1060	2019/06/09	20:30:30.66	51°12'41.166"N	141°47'02.634"E	554766.7	5673629.8	043.66
0006_C_L_HR_29	1070	2019/06/09	20:31:00.72	51°12'42.981"N	141°47'04.028"E	554793.2	5673686.1	043.72
0006_C_L_HR_29	1080	2019/06/09	20:31:30.64	51°12'44.791"N	141°47'05.441"E	554820.0	5673742.3	043.59

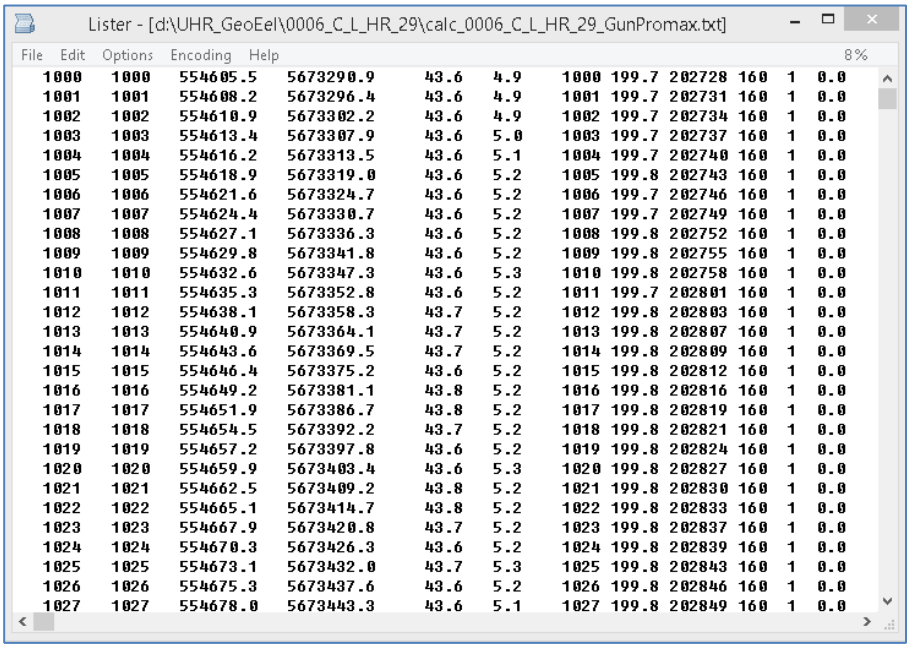
Figure 65. File with “coordinate’s catalogue”

There are follow data-columns contained in the file:
FileName – the survey line name;
PointNum – the Fix number for 2DHR;
Date – shot’s date;
Time – shot’s time;
Latitude – latitude of objects in accordance with navigation datum;
Longitude – longitude of objects in accordance with navigation datum;
Easting – easting of objects in accordance with navigation datum;
Northing – Northing of objects in accordance with navigation datum;
WaterDepth – the actual water depth for object (Gun or CMP1) position.

5.3 ProMax source geometry spreadsheet

The current chapter based on document: “ProMAX® Reference 2D and 3D Marine Geometry Assignment”.

The example of file, contained spreadsheet for ProMax “2D Marine Geometry Assignment” procedure, shown in Figure 66.


Lister - [d:\UHR_GeoEel\0006_C_L_HR_29\calc_0006_C_L_HR_29_GunPromax.txt]
File Edit Options Encoding Help 8%

1000	1000	554605.5	5673290.9	43.6	4.9	1000	199.7	202728	160	1	0.0
1001	1001	554608.2	5673296.4	43.6	4.9	1001	199.7	202731	160	1	0.0
1002	1002	554610.9	5673302.2	43.6	4.9	1002	199.7	202734	160	1	0.0
1003	1003	554613.4	5673307.9	43.6	5.0	1003	199.7	202737	160	1	0.0
1004	1004	554616.2	5673313.5	43.6	5.1	1004	199.7	202740	160	1	0.0
1005	1005	554618.9	5673319.0	43.6	5.2	1005	199.8	202743	160	1	0.0
1006	1006	554621.6	5673324.7	43.6	5.2	1006	199.7	202746	160	1	0.0
1007	1007	554624.4	5673330.7	43.6	5.2	1007	199.7	202749	160	1	0.0
1008	1008	554627.1	5673336.3	43.6	5.2	1008	199.8	202752	160	1	0.0
1009	1009	554629.8	5673341.8	43.6	5.2	1009	199.8	202755	160	1	0.0
1010	1010	554632.6	5673347.3	43.6	5.3	1010	199.8	202758	160	1	0.0
1011	1011	554635.3	5673352.8	43.6	5.2	1011	199.7	202801	160	1	0.0
1012	1012	554638.1	5673358.3	43.7	5.2	1012	199.8	202803	160	1	0.0
1013	1013	554640.9	5673364.1	43.7	5.2	1013	199.8	202807	160	1	0.0
1014	1014	554643.6	5673369.5	43.7	5.2	1014	199.8	202809	160	1	0.0
1015	1015	554646.4	5673375.2	43.6	5.2	1015	199.8	202812	160	1	0.0
1016	1016	554649.2	5673381.1	43.8	5.2	1016	199.8	202816	160	1	0.0
1017	1017	554651.9	5673386.7	43.8	5.2	1017	199.8	202819	160	1	0.0
1018	1018	554654.5	5673392.2	43.7	5.2	1018	199.8	202821	160	1	0.0
1019	1019	554657.2	5673397.8	43.6	5.2	1019	199.8	202824	160	1	0.0
1020	1020	554659.9	5673403.4	43.6	5.3	1020	199.8	202827	160	1	0.0
1021	1021	554662.5	5673409.2	43.8	5.2	1021	199.8	202830	160	1	0.0
1022	1022	554665.1	5673414.7	43.8	5.2	1022	199.8	202833	160	1	0.0
1023	1023	554667.9	5673420.8	43.7	5.2	1023	199.8	202837	160	1	0.0
1024	1024	554670.3	5673426.3	43.6	5.2	1024	199.8	202839	160	1	0.0
1025	1025	554673.1	5673432.0	43.7	5.3	1025	199.8	202843	160	1	0.0
1026	1026	554675.3	5673437.6	43.6	5.2	1026	199.8	202846	160	1	0.0
1027	1027	554678.0	5673443.3	43.6	5.1	1027	199.8	202849	160	1	0.0

Figure 66. File with spreadsheet for ProMax “2D Marine Geometry Assignment”

There are follow data-columns contained in the file:

MarkBlock – Mark Block is assigned to the TRC GEOMETRY SIN database attribute in the Assign midpoints step in Bin. This column is also a spreadsheet row counter.

Source – Source is a user defined source numbering sequence.

Station – Station is required for Assign midpoints step in Bin. The station number is associated with the shot as determined from the acquisition survey.

X – X is required for Assign midpoints step in Bin. X coordinate of the source in feet or meters. This is obtained from the navigation data or can be extracted from dataset headers that contain X coordinates. This can be the X coordinate of either the center of the source array or the antennae on the boat.

Y – Y is required for Assign midpoints step in Bin. Y coordinate of the source in feet or meters. This is obtained from the navigation data or can be extracted from dataset headers that contain Y coordinates. This can be the Y coordinate of either the center of the source array or the antennae on the boat.

DepthSea – Depth: is the water depth at the source location in ft. or m.

SrcDepth – Src Depth is the depth of the source in ft. or m.

FFID – FFID is the field file ID. This is usually the tape file number assigned to each shot at time of recording. Therefore, these numbers usually reflect the chronological order of the shots. FFID is normally obtained from the field observer’s notes.

StrmrAzmth – Strmr Azmth is the direction measured relative to North of the line extending from the stern of the vessel towards the streamer tail buoy. Value entered should be the clockwise bearing in degrees from North (0 degrees).

Time – HHMMSS - Time is the time of shot.

Date – Julian Date is the date of shot.

SrcPattern – Pattern is the source pattern number corresponding to values in the Src Pattern column in the Patterns spreadsheet. Source patterns are defined in the Patterns spreadsheet.

Static – Static is a user defined static in ms. If pre-existing shot statics are going to be applied to a dataset, they can be entered in this column. For example, shot time delays due to time break errors during recording could be entered in this column. These statics can later be applied with Apply User Statics.

5.4 Sgy with Navigation merged

The current chapter based on documents: “Recommended standards for digital tape formats, 1975 Society of Exploration Geophysicists. All rights reserved.” (Sgy rev.0); “SEG Y rev 1 Data Exchange format1, SEG Technical Standards Committee2, Release 1.0, May 2002”; “GS.64 – EXXONMOBIL GEOPHYSICAL OPERATIONS, Generic Specifications High Resolution (HR) Seismic: Seismic Data Processing.”, rev. 02.

The Sgy file includes changed Text-header, Binary-header and Trace-headers. The comments to fields are exception to standard Sgy, marked red fonts color.

5.4.1 Text-header

The Text-header formed using txt-file with Header, located in the root-folder of data. The file example is shown in Figure 67. The symbols marked as ### are automatically changed for file will created, using actual data. The each change is defined to script’s code.

The most lines in the Text-header are a “free format”. The lines defined by client as “Buyer specified SEGY EBCDIC Header contents” marked with postfix “DEF”.

The Text-header merged to Sgy file shown in Figure 68.

Lister - [d:\UHR_GeoEel\Sgy_TextHeader.txt]

File Edit Options Encoding Help 100 %

```
C01 CLIENT:EXXON MOBIL; CONTRACTOR:ROMONA; VESSEL:IVAN KIREEV; SURVEY:MALMA2DHR
C02 LINE ############ AREA 54NN                  MAP ID                         DEF
C03 SEQNO:####; DATE:####-##-##; PRODUCT TYPE:RAW TRACES MERGED WITH NAV DATA
C04 RECORDING SYSTEM:GEOMETRICS GEOEEL CNT-2; FORMAT:SEG-Y REV.1;
C05 DATA TRACES/RECORD #### AUXILIARY TRACES/RECORD ## CDP FOLD 96             DEF
C06 SAMPLE INTERVAL #.###   SAMPLES/TRACE ##### BITS/IN 24   BYTES/SAMPLE    DEF
C07 TRACES SORTED BY:RECORD; POLARITY:NORMAL SEG; PHASE:AS RECORDED;
C08 SAMPLE CODE: 32 BIT IBM FLOATING    BYTE ORDER: BIG ENDIAN                 DEF
C09 AMPLITUDE RECOVERY:NONE; REC.LENGTH:####.###MS; GAIN TYPE:FIXED
C10 STREAMER:GEOEEL SOLID; HYDROPHONE TYPE:GEOMETRICS PROPRIETARY POLYMER
C11 GROUP INT:6.25M; GEOPHONES:PER GROUP 6; SPACING:0.65M; GROUP SENS:20 V/BAR
C12 ADC BANDWIDTH:DC TO 8 KHZ; ADC DYNAMIC RANGE:120 DB @ 1MS, 70 DB @ 1/16MS
C13 ADC FILTERS:ALIAS -3 DB @ 81% OF NYQUIST, DOWN 135 DB AT STOP BAND
C14 STREAMERS NO:1; ACTIVE LENGTH:####.###M; STREAMER DEPTH:2M (+/-0.5M);
C15 BIRDS:##; MIN OFFSET ALONG:10M; MIN OFFSET TRANSVERSE:8M
C16 SOURCE:SERCEL G.GUN 150CU - M 9/16 JIC; NUM:1; SHOT POINT INTERVAL:##.###M
C17 SOURCE CONTROLLER:SEAMAP GUNLINK 2000; NEAR FIELD HYDROPHONE:AUX.TRACE 1
C18 MANIFOLD PRESSURE:2000PSI (+/-100); GUN DEPTH:3M (+/-0.5)
C19 TIMING GUNS FIRE DELAY 40MS AFTER NAV CLOSURE (DELAY CORRECTION 0MS)
C20 MAP PROJECTION:UTM 54N; GRID UNITS:METERS; CENTRAL MERIDIAN:141 00 00.000W
C21 GRID ORIGIN:0 00 00.000N; UTM ZONE:54N; SCALE:0.9996
C22 GEODETIC DATUM:WGS 84, 6378137.000; INVERSE FLATTENING:298.2572235630
C23 FIRST CMP ALONG SURVEY LINE; SHOTS BY VESSEL CRP; SEISMIC DISTANCE
C24
C25
C26
C27  SHOTPOINT RANGE: min ##### - max #####                                    DEF
C28
C29
C30 NON-STANDARD TRACE HEADERS: SHOT TIME MICROSECOND 189-192 INT32; RECEIVER
C31 DEPTH 193-196 INT32; AUX DATA TO CHANNELS MANTISSA 225-228 INT32; AUX DATA
C32 TO CHANNELS EXPONENTA 229-230 INT16.              AUX DATA TO CHANNELS MAP:
C33 CH1:VESSEL HEADING; CH2:GUN TP-X; CH3:GUN TP-Y; CH4:MANIFOLD PSI
C34 CH5:ATMOSFER PSI; CH6:CLUSTER NUM; CH7:GUNS VOLUME CU; CH8-11:GUNS DT MCSEC
C35 CH12:ST TP-X; CH13:ST TP-Y; CH14:ST TAIL-X; CH15:ST TAIL-Y; CH16:ST HEADING
C36 CH17:ST TENSION; CH18:ST REPEATER DEPTH; CH19-31:BIRDS DEPTH
C37 CH32-44:BIRDS HEADING; CH45-57: BIRDS WING ANGLE; CH58-70:BIRDS TEMPERATURE
C38 BIRDS DISTANCE FROM TP: 62.2; 162.2; 262.2; 362.2; 462.2; 562.2; 662.2;
C39 762.2; 862.2; 962.2; 1062.2; 1162.2; 1262.2; TAIL DISTANCE FROM TP: 1418.4
C40 END EBCDIC
```

Figure 67. The template file for Text-header

Summary | Text Header | Bin Header | Trace Header | Trace Data

```
C01 CLIENT:EXXON MOBIL; CONTRACTOR:ROMONA; VESSEL:IVAN KIREEV; SURVEY:MALMA2DHR
C02 LINE 0006_C_L_HR_29REA 54NN                  MAP ID                        DEF
C03 SEQNO:R_29; DATE:2019-06-06; PRODUCT TYPE:RAW TRACES MERGED WITH NAV DATA
C04 RECORDING SYSTEM:GEOMETRICS GEOEEL CNT-2; FORMAT:SEG-Y REV.1;
C05 DATA TRACES/RECORD 0192 AUXILIARY TRACES/RECORD 04 CDP FOLD 96            DEF
C06 SAMPLE INTERVAL 0.500   SAMPLES/TRACE 04000 BITS/IN 24   BYTES/SAMPLE   DEF
C07 TRACES SORTED BY:RECORD; POLARITY:NORMAL SEG; PHASE:AS RECORDED;
C08 SAMPLE CODE: 32 BIT IBM FLOATING    BYTE ORDER: BIG ENDIAN                DEF
C09 AMPLITUDE RECOVERY:NONE; REC.LENGTH:2000.000MS; GAIN TYPE:FIXED
C10 STREAMER:GEOEEL SOLID; HYDROPHONE TYPE:GEOMETRICS PROPRIETARY POLYMER
C11 GROUP INT:6.25M; GEOPHONES:PER GROUP 6; SPACING:0.65M; GROUP SENS:20 V/BAR
C12 ADC BANDWIDTH:DC TO 8 KHZ; ADC DYNAMIC RANGE:120 DB @ 1MS, 70 DB @ 1/16MS
C13 ADC FILTERS:ALIAS -3 DB @ 81% OF NYQUIST, DOWN 135 DB AT STOP BAND
C14 STREAMERS NO:1; ACTIVE LENGTH:1193.750M; STREAMER DEPTH:2M (+/-0.5M);
C15 BIRDS:13; MIN OFFSET ALONG:10M; MIN OFFSET TRANSVERSE:8M
C16 SOURCE:SERCEL G.GUN 150CU - M 9/16 JIC; NUM:1; SHOT POINT INTERVAL:06.250M
C17 SOURCE CONTROLLER:SEAMAP GUNLINK 2000; NEAR FIELD HYDROPHONE:AUX.TRACE 1
C18 MANIFOLD PRESSURE:2000PSI (+/-100); GUN DEPTH:3M (+/-0.5)
C19 TIMING GUNS FIRE DELAY 40MS AFTER NAV CLOSURE (DELAY CORRECTION 0MS)
C20 MAP PROJECTION:UTM 54N; GRID UNITS:METERS; CENTRAL MERIDIAN:141 00 00.000W
C21 GRID ORIGIN:0 00 00.000N; UTM ZONE:54N; SCALE:0.9996
C22 GEODETIC DATUM:WGS 84, 6378137.000; INVERSE FLATTENING:298.2572235630
C23 FIRST CMP ALONG SURVEY LINE; SHOTS BY VESSEL CRP; SEISMIC DISTANCE
C24
C25
C26
C27  SHOTPOINT RANGE: min 01000 - max 01353                                    DEF
C28
C29
C30 NON-STANDARD TRACE HEADERS: SHOT TIME MICROSECOND 189-192 INT32; RECEIVER
C31 DEPTH 193-196 INT32; AUX DATA TO CHANNELS MANTISSA 225-228 INT32; AUX DATA
C32 TO CHANNELS EXPONENTA 229-230 INT16.              AUX DATA TO CHANNELS MAP:
C33 CH1:VESSEL HEADING; CH2:GUN TP-X; CH3:GUN TP-Y; CH4:MANIFOLD PSI
C34 CH5:ATMOSFER PSI; CH6:CLUSTER NUM; CH7:GUNS VOLUME CU; CH8-11:GUNS DT MCSEC
C35 CH12:ST TP-X; CH13:ST TP-Y; CH14:ST TAIL-X; CH15:ST TAIL-Y; CH16:ST HEADING
C36 CH17:ST TENSION; CH18:ST REPEATER DEPTH; CH19-31:BIRDS DEPTH
C37 CH32-44:BIRDS HEADING; CH45-57: BIRDS WING ANGLE; CH58-70:BIRDS TEMPERATURE
C38 BIRDS DISTANCE FROM TP: 62.2; 162.2; 262.2; 362.2; 462.2; 562.2; 662.2;
C39 762.2; 862.2; 962.2; 1062.2; 1162.2; 1262.2; TAIL DISTANCE FROM TP: 1418.4
C40 END EBCDIC
```

Figure 68. Text-header merged to Sgy file

5.4.2 Binary-header

The Binary-header includes follow corrected fields:

Bytes 3201-3204 // Job – Job identification number.

Bytes 3205-3208 // Line – Line number. For 3-D post-stack data, this will typically contain the in-line number.

Bytes 3209-3212 // Reel – Reel number.

Bytes 3213-3214 // DataTracePerEnsemble – Number of data traces per ensemble. Mandatory for prestack data.

Bytes 3215-3216 // AuxiliaryTracePerEnsemble – Number of auxiliary traces per ensemble. Mandatory for prestack data.

Bytes 3217-3218 // dt – Sample interval in microseconds (μs). Mandatory for all data types.

Bytes 3219-3220 // dtOrig – Sample interval in microseconds (μs) of original field recording.

Bytes 3221-3222 // ns – Number of samples per data trace. Mandatory for all types of data. Note: The sample interval and number of samples in the Binary File Header should be for the primary set of seismic data traces in the file.

Bytes 3223-3224 // nsOrig – Number of samples per data trace for original field recording.

Bytes 3225-3226 // DataSampleFormat=1 – Data sample format code. Mandatory for all data. 1=4-byte IBM floating-point; 2=4-byte, two's complement integer; 3=2-byte, two's complement integer; 4=4-byte fixed-point with gain (obsolete); 5=4-byte IEEE floating-point; 6=Not currently used; 7=Not currently used; 8=1-byte, two's complement integer.

Bytes 3229-3230 // TraceSorting=1 – Trace sorting code (i.e. type of ensemble) : -1=Other (should be explained in user Extended Textual File Header stanza; 0=Unknown; 1=As recorded (no sorting); 2=CDP ensemble; 3=Single fold continuous profile; 4=Horizontally stacked; 5=Common source point; 6=Common receiver point; 7=Common offset point; 8=Common mid-point; 9=Common conversion point. Highly recommended for all types of data.

Bytes 3231-3232 // VerticalSumCode=1 – Vertical sum code: 1 = no sum, 2 = two sum, …, N = M-1 sum (M = 2 to 32,767).

Bytes 3255-3256 // MeasurementSystem=1 – Measurement system: Highly recommended for all types of data. If Location Data stanzas are included in the file, this entry must agree with the Location Data stanza. If there is a disagreement, the last Location Data stanza is the controlling authority. 1=Meters; 2=Feet.

Bytes 3261-3500 // Unassigned1=[2 1 0 0 0 0 0 0 0 0]

Bytes #3261-3262 // Data type=2 – Exxon: 1=Land2D, 2=Marine2D, 3=Land3D, 4=Marine3D.

Bytes #3263-3264 // Coordinate flag=1 – Exxon: 0=No coordinate in trace headers, 1=Coordinates in trace headers.

Bytes #3265-3266 // Statics flag=0 – Exxon: 0=No statics in trace headers, 1=Statics in trace headers.

Bytes 3501-3502 // SegyFormatRevisionNumber=0 – SEG Y Format Revision Number. This is a 16-bit unsigned value with a Q-point between the first and second bytes. Thus for SEG Y Revision 1.0, as defined in this document, this will be recorded as 0100. This field is mandatory for all versions of SEG Y, although a value of zero indicates "traditional" SEG Y conforming to the 1975 standard.

Bytes 3503-3504 // FixedLengthTraceFlag=0 – Fixed length trace flag. A value of one indicates that all traces in this SEG Y file are guaranteed to have the same sample interval and number of samples, as specified in Textual File Header bytes 3217-3218 and 3221-3222. A value of zero indicates that the length of the traces in the file may vary and the number of samples in bytes 115-116 of the Trace Header must be examined to determine the actual length of each trace. This field is mandatory for all versions of SEG Y, although a value of zero indicates "traditional" SEG Y conforming to the 1975 standard.

Bytes 3505-3506 // NumberOfExtTextualHeaders=0 – Number of 3200-byte, Extended Textual File Header records following the Binary Header. A value of zero indicates there are no Extended Textual File Header records (i.e. this file has no Extended Textual File Header(s)). A value of -1 indicates that there are a variable number of Extended Textual File Header records and the end of the Extended Textual File Header is denoted by an ((SEG: EndText)) stanza in the final record.

The example of output Sgy-file Binary header is shown in Figure 69.

Variables - SgyHead

SgyHead

1x1 struct with 39 fields

Field	Value	Min	Max	Class
Descript	*1x1 struct*			struct
fName	'd:\UHR_GeoEel\\0006_C_L_H...			char
Endian	'b'			char
FDataSampleFormat	1	1	1	double
TextualFileHeader	*3200x1 char*			char
Job	25	25	25	double
Line	629	629	629	double
Reel	6	6	6	double
DataTracePerEnsemble	192	192	192	double
AuxiliaryTracePerEnsemble	4	4	4	double
dt	500	500	500	double
dtOrig	500	500	500	double
ns	4000	4000	4000	double
nsOrig	4000	4000	4000	double
DataSampleFormat	1	1	1	double
EnsembleFold	0	0	0	double
TraceSorting	1	1	1	double
VerticalSumCode	1	1	1	double
SweepFrequencyStart	0	0	0	double
SweepFrequencyEnd	0	0	0	double
SweepLength	0	0	0	double
SweepType	0	0	0	double
SweepChannel	0	0	0	double
SweepTaperlengthStart	0	0	0	double
SweepTaperLengthEnd	0	0	0	double
TaperType	0	0	0	double
CorrelatedDataTraces	0	0	0	double
BinaryGain	0	0	0	double
AmplitudeRecoveryMethod	0	0	0	double
MeasurementSystem	1	1	1	double
ImpulseSignalPolarity	0	0	0	double
VibratoryPolarityCode	0	0	0	double
Unassigned1	*120x1 double*	0	2	double
SegyFormatRevisionNumber	0	0	0	double
FixedLengthTraceFlag	0	0	0	double
NumberOfExtTextualHeaders	0	0	0	double
Unassigned2	*47x1 double*	0	0	double
ExtTextualHeaders	*[]*			double
fNameTmp	'd:\UHR_GeoEel\\0006_C_L_H...			char

Figure 69. Example of output Sgy-file Binary header

5.4.3 Trace-headers

The Trace-headers includes follow corrected fields:

01-04 // TraceSequenceLine – Trace sequence number within line — Numbers continue to increase if the same line continues across multiple SEG Y files. Highly recommended for all types of data.

09-12 // FieldRecord==ShotID – Original field record number. Highly recommended for all types of data.

13-16 // TraceNumber – Trace number within the original field record. Highly recommended for all types of data.

17-20 // EnergySourcePoint==Fix – Energy source point number — Used when more than one record occurs at the same effective surface location. It is recommended that the new entry defined in Trace Header bytes 197-202 be used for shotpoint number.

29-30 // TraceIdenitifactionCode – Trace identification code: -1=Other; 0=Unknown; 1=Seismic data; 2=Dead; 3=Dummy; 4=Time break; 5=Uphole; 6=Sweep; 7=Timing; 8=Waterbreak; 9=Near-field gun signature; 10=Far-field gun signature; 11=Seismic pressure sensor; 12=Multicomponent seismic sensor - Vertical component; 13=Multicomponent seismic sensor - Cross-line component; 14=Multicomponent seismic sensor - In-line component; 15=Rotated multicomponent seismic sensor - Vertical component; 16=Rotated multicomponent seismic sensor - Transverse component; 17=Rotated multicomponent seismic sensor - Radial component; 18=Vibrator reaction mass; 19=Vibrator baseplate; 20=Vibrator estimated ground force; 21=Vibrator reference; 22=Time-velocity pairs; 23 … N=optional use, (maximum N = 32,767). Highly recommended for all types of data.

31-32 // NSummedTraces=1 – Automatically set by GeoEel // Number of vertically summed traces yielding this trace. (1 is one trace, 2 is two summed traces, etc.)

33-34 // NStackedTraces=1 – Automatically set by GeoEel // Number of horizontally stacked traces yielding this trace. (1 is one trace, 2 is two stacked traces, etc.)

35-36 // DataUse – Data use: 1=Production; 2=Test.

37-40 // offset – Distance from center of the source point to the center of the receiver group (negative if opposite to direction in which line is shot).

49-52 // SourceDepth – Source depth below surface (a positive number).

61-64 // SourceWaterDepth – Water depth at source.

65-68 // GroupWaterDepth – Water depth at group.

69-70 // ElevationScalar=-100 – Scalar to be applied to all elevations and depths specified in Trace Header bytes 41-68 to give the real value. Scalar = 1, +10, +100, +1000, or +10,000. If positive, scalar is used as a multiplier; if negative, scalar is used as a divisor.

71-72 // SourceGroupScalar=-100 – Scalar to be applied to all coordinates specified in Trace Header bytes 73-88 and to bytes Trace Header 181-188 to give the real value. Scalar = 1, +10, +100, +1000, or +10,000. If positive, scalar is used as a multiplier; if negative, scalar is used as divisor.

73-76 // SourceX – Source coordinate - X.

77-80 // SourceY – Source coordinate - Y.

81-84 // GroupX – Group coordinate - X.

85-88 // GroupY – Group coordinate - Y.

89-90 // CoordinateUnits=1 – Coordinate units: 1=Length (meters or feet); 2=Seconds of arc; 3=Decimal degrees; 4=Degrees, minutes, seconds (DMS). Note: To encode +-DDDMMSS bytes 89-90 equal= +-DDD*10^4 + MM*10^2 + SS with bytes 71-72 set to 1; To encode +-DDDMMSS.ss bytes 89-90 equal= +-DDD*10^6 + MM*10^4 + SS*10^2 with bytes 71-72 set to -100.

91-92 // WeatheringVelocity – Water or Weathering velocity. (ft/s or m/s as specified in Binary File Header bytes 3255-3256).

109-110 // DelayRecordingTime – Delay recording time — Time in milliseconds between initiation time of energy source and the time when recording of data samples begins. In SEG Y rev 0 this entry was intended for deep-water work if data recording does not start at zero time. The entry can be negative to accommodate negative start times (i.e. data recorded before time zero, presumably as a result of static application to the data trace). If a non-zero value (negative or positive) is recorded in this entry, a comment to that effect should appear in the Textual File Header.

115-116 // ns – Automatically set by GeoEel // Number of samples in this trace. Highly recommended for all types of data.

117-118 // dt – Automatically set by GeoEel // Sample interval in microseconds (μs) for this trace. The number of bytes in a trace record must be consistent with the number of samples written in the trace header. This is important for all recording media; but it is particularly crucial for the correct processing of SEG Y data in disk files (see Appendix C). If the fixed length trace flag in bytes 3503-3504 of the Binary File Header is set, the sample interval and number of samples in every trace in the SEG Y file must be the same as the values recorded in the Binary File Header. If the fixed length trace flag is not set, the sample interval and number of samples may vary from trace to trace. Highly recommended for all types of data.

119-120 // GainType=1 – Gain type of field instruments: 1=fixed; 2=binary; 3=floating point; 4 … N=optional use.

121-122 // InstrumentGainConstant – Instrument gain constant (dB).

123-124 // InstrumentInitialGain – Instrument early or initial gain (dB).

157-158 // YearDataRecorded – Year data recorded — The 1975 standard is unclear as to whether this should be recorded as a 2-digit or a 4-digit year and both have been used. For SEG Y revisions beyond rev 0, the year should be recorded as the complete 4-digit Gregorian calendar year (i.e. the year 2001 should be recorded as 2001 (7D1)).

159-160 // DayOfYear – Day of year (Julian day for GMT and UTC time basis).

161-162 // HourOfDay – Hour of day (24 hour clock).

163-164 // MinuteOfHour – Minute of hour.

165-166 // SecondOfMinute – Second of minute.

167-168 // TimeBaseCode=4 – Time basis code: 1=Local; 2=GMT (Greenwich Mean Time); 3=Other, should be explained in a user defined stanza in the Extended Textual File Header; 4=UTC (Coordinated Universal Time).

189-192 // Inline3D – used as microsecond. Usually for 3-D poststack data, this field should be used for the in-line number. If one in-line per SEG Y file is being recorded, this value should be the same for all traces in the file and the same value will be recorded in bytes 3205-3208 of the Binary File Header.

193-196 // Crossline3D – used as Receiver/Cable depth below surface. Usually for 3-D poststack data, this field should be used for the cross-line number. This will typically be the same value as the ensemble (CDP) number in Trace Header bytes 21-24, but this does not have to be the case.

225-228 // SourceMeasurementMantissa – used as AdditionalInformation mantissa. Usually Source Measurement — Describes the source effort used to generate the trace. The measurement can be simple, qualitative measurements such as the total weight of explosive used or the peak air gun pressure or the number of vibrators times the sweep duration. Although these simple measurements are acceptable, it is preferable to use true measurement units of energy or work. The constant is encoded as a four-byte, two's complement integer (bytes 225-228) which is the mantissa and a two-byte, two's complement integer (bytes 209-230) which is the power of ten exponent (i.e. Bytes 225-228 * 10**Bytes 229-230).

229-230 // SourceMeasurementExponent – used as AdditionalInformation exponent. Usually two-byte, two's complement integer (bytes 209-230) which is the power of ten exponent (i.e. Bytes 225-228 * 10**Bytes 229-230).

231-232 // SourceMeasurementUnit=-1 Source Measurement Unit — The unit used for the Source Measurement, Trace header bytes 225-230. -1 = Other (should be described in Source Measurement Unit stanza, page 39); 0=Unknown; 1=Joule(J); 2=Kilowatt(kW); 3=Pascal(Pa); 4=Bar(Bar); 4=Bar-meter(Bar-m); 5=Newton(N); 6=Kilograms(kg).

The AdditionalInformation (Bytes 225-228 * 10**Bytes 229-230) write to one or more Channels. There are follow information:

1 – vessel heading;
2 – GunTowPointX;
3 – GunTowPointY;
4 – Manifold pressure in psi;
5 – Atmosferic pressure in psi;
6 – cluster number;
7 – cluster's guns volume;
8 – guns error in microsecond;
9 – StreamerTowPointX;
10 – StreamerTowPointY;
11 – Streamer's Buoy X;
12 – Streamer's Buoy Y;
13 – Streamer's heading (towpoint-to-tail) in degree;
14 – Streamer's tension;
15 – Streamer's depth by repeater in m;
16 – Birds depth in m;
17 – Birds heading in degree;
18 – Birds wing angle;
19 – Birds temperature.

The length of each position depends from “objects number”. For example, we have 4 guns installed in cluster, so we will have 4 “guns error in microsecond” records; if we have 10 birds, – we will have 10 “Birds depth”, “Birds heading”, “Birds wing angle” and “Birds temperature”.

The example of output Sgy-file Trace headers is shown in Figure 70 and Figure 71.

Variables - Head

Head

1x1 struct with 92 fields

Field	Value	Min	Max	Class
MessageNum	1x70952 double	1	70952	double
TraceSequenceLine	1x70952 double	1	70952	double
TraceSequenceFile	1x70952 double	0	0	double
FieldRecord	1x70952 double	996	1357	double
TraceNumber	1x70952 double	1	196	double
EnergySourcePoint	1x70952 double	0	1355	double
cdp	1x70952 double	0	0	double
cdpTrace	1x70952 double	0	0	double
TraceIdenitifactionCode	1x70952 double	1	9	double
NSummedTraces	1x70952 double	1	1	double
NStackedTraces	1x70952 double	1	1	double
DataUse	1x70952 double	1	2	double
offset	1x70952 double	-1.2041e+03	0	double
ReceiverGroupElevation	1x70952 double	0	0	double
SourceSurfaceElevation	1x70952 double	0	0	double
SourceDepth	1x70952 double	0	568	double
ReceiverDatumElevation	1x70952 double	0	0	double
SourceDatumElevation	1x70952 double	0	0	double
SourceWaterDepth	1x70952 double	0	4.3833e+03	double
GroupWaterDepth	1x70952 double	0	4.3915e+03	double
ElevationScalar	1x70952 double	-100	-100	double
SourceGroupScalar	1x70952 double	-100	-100	double
SourceX	1x70952 double	0	5.5556e+07	double
SourceY	1x70952 double	0	5.6753e+08	double
GroupX	1x70952 double	0	5.5556e+07	double
GroupY	1x70952 double	0	5.6753e+08	double
CoordinateUnits	1x70952 double	1	1	double
WeatheringVelocity	1x70952 double	1470	1470	double
SubWeatheringVelocity	1x70952 double	0	0	double
SourceUpholeTime	1x70952 double	0	0	double
GroupUpholeTime	1x70952 double	0	0	double
SourceStaticCorrection	1x70952 double	0	0	double
GroupStaticCorrection	1x70952 double	0	0	double
TotalStaticApplied	1x70952 double	0	0	double
LagTimeA	1x70952 double	0	0	double
LagTimeB	1x70952 double	0	0	double
DelayRecordingTime	1x70952 double	0	0	double
MuteTimeStart	1x70952 double	0	0	double
MuteTimeEnd	1x70952 double	0	0	double
ns	1x70952 double	4000	4000	double
dt	1x70952 double	500	500	double
GainType	1x70952 double	1	1	double
InstrumentGainConstant	1x70952 double	8	16	double
InstrumentInitialGain	1x70952 double	8	16	double
Correlated	1x70952 double	0	0	double
SweepFrequenceStart	1x70952 double	0	0	double
SweepFrequenceEnd	1x70952 double	0	0	double
SweepLength	1x70952 double	0	0	double
SweepType	1x70952 double	0	0	double

Figure 70. Example of output Sgy-file Trace headers; part 1

Variables - Head

Head

1x1 struct with 92 fields

Field	Value	Min	Max	Class
InstrumentInitialGain	1x70952 double	8	16	double
Correlated	1x70952 double	0	0	double
SweepFrequenceStart	1x70952 double	0	0	double
SweepFrequenceEnd	1x70952 double	0	0	double
SweepLength	1x70952 double	0	0	double
SweepType	1x70952 double	0	0	double
SweepTraceTaperLengthStart	1x70952 double	0	0	double
SweepTraceTaperLengthEnd	1x70952 double	0	0	double
TaperType	1x70952 double	0	0	double
AliasFilterFrequency	1x70952 double	0	0	double
AliasFilterSlope	1x70952 double	0	0	double
NotchFilterFrequency	1x70952 double	0	0	double
NotchFilterSlope	1x70952 double	0	0	double
LowCutFrequency	1x70952 double	0	0	double
HighCutFrequency	1x70952 double	0	0	double
LowCutSlope	1x70952 double	0	0	double
HighCutSlope	1x70952 double	0	0	double
YearDataRecorded	1x70952 double	2019	2019	double
DayOfYear	1x70952 double	160	161	double
HourOfDay	1x70952 double	7	20	double
MinuteOfHour	1x70952 double	24	47	double
SecondOfMinute	1x70952 double	0	59	double
TimeBaseCode	1x70952 double	4	4	double
TraceWeightningFactor	1x70952 double	0	0	double
GeophoneGroupNumberRoll	1x70952 double	0	0	double
GeophoneGroupNumberFirstT...	1x70952 double	0	0	double
GeophoneGroupNumberLastT...	1x70952 double	0	0	double
GapSize	1x70952 double	0	0	double
OverTravel	1x70952 double	0	0	double
cdpX	1x70952 double	0	0	double
cdpY	1x70952 double	0	0	double
Inline3D	1x70952 double	0	9.9006e+05	double
Crossline3D	1x70952 double	0	606.5560	double
ShotPoint	1x70952 double	0	0	double
ShotPointScalar	1x70952 double	0	0	double
TraceValueMeasurementUnit	1x70952 double	0	0	double
TransductionConstantMantissa	1x70952 double	0	0	double
TransductionConstantPower	1x70952 double	0	0	double
TransductionUnit	1x70952 double	0	0	double
TraceIdentifier	1x70952 double	0	0	double
ScalarTraceHeader	1x70952 double	0	0	double
SourceType	1x70952 double	0	0	double
SourceEnergyDirectionMantissa	1x70952 double	0	0	double
SourceEnergyDirectionExponent	1x70952 double	0	0	double
SourceMeasurementMantissa	1x70952 double	-1.6029e+04	5.6753e+08	double
SourceMeasurementExponent	1x70952 double	-3	0	double
SourceMeasurementUnit	1x70952 double	-1	-1	double
UnassignedInt1	1x70952 double	0	0	double
UnassignedInt2	1x70952 double	0	0	double

Figure 71. Example of output Sgy-file Trace headers; part 2

6 Appendix 1: Raw 2D marine SEG-Y data requirements by Exxon Mobile

The current chapter based on document: "GS.64 – EXXONMOBIL GEOPHYSICAL OPERATIONS, Generic Specifications High Resolution (HR) Seismic: Seismic Data Processing.", rev. 02.

6.1 SEGY 3200 Byte EBCDIC header

The EBCDIC header must include:

1) Geodetic Datum. The EBCDIC header must state the geodetic datum used for the coordinates. The acquisition geodetic information: Ellipsoid, Latitude of Origin, Semi Major Axis, Scale Factor, Coefficient of Flattening, False Easting, Datum Name, False Northing, Projection, Units, Central Meridian, Zone Name;

2) Detailed header byte location listing.

3) Buyer specified SEGY EBCDIC Header contents (for Raw Sgy):

Card No	Item Description	Byte Positions	Notes
C 2	Line (2D) or Survey (3D) name and Area Code	84-160	See additional note (*) below
C 5	Data traces per record	404-480	
C 6	Sample interval	484-540	
C 8	Byte order	601-640	Indicate whether byte order is Big or Little Endian. Note: Big-Endian is the only format acceptable to Buyer.
C27	Shotpoint range / Sub-range for 2D or Inline/crossline range for 3D	2084-2160	Sub-ranges are to be used when a single 2D line (pre-stack) or 3D survey spans multiple physical output media.

(*) C2 additional note:

The complete Buyer specified alphanumeric Line Name (for 2D data) or Survey Name (for 3D data) shall be written to card image C2 of the EBCDIC header. The Line Name shall not exceed 12 characters in length. The name shall be unique and allow unambiguous identification of the associated trace data. The format of card image C2 in the EBCDIC Header will conform to the following:

-- Columns 1-3 will be 'C 2;

-- The word 'LINE' will precede the Buyer alphanumeric line name with at least one blank space separating the word 'LINE' and the alphanumeric line name;

-- The word 'AREA' will follow the alphanumeric line name separated by at least one space from the last character in the line name;

-- The Buyer's designated Area Code will be located after the word 'AREA' separated by at least one space from the last character in the word area.

4) Trace sample values. Units are millivolts referred to the input of the acquisition system. If the sample values are not in units of millivolts, the actual engineering units used must be stated in the EBCDIC header.

5) Tidal corrections. The EBCDIC header should clearly state whether tidal corrections have been applied or not applied to depth measurements. If tidal corrections are applied, the calculation method must be stated.
6) Channel sampling skew. Skew removed from data traces or recorded in trace header. The EBCDIC header must state if channel skew has or has not been removed from the data traces.
7) System time delays. System delays removed from data traces or recorded in trace header. The EBCDIC header must state how system time delays are treated.
8) Sensor transduction constants. Include in EBCDIC header with transduction units. Clearly state in the EBCDIC header the transduction factors to be used to convert the SEGY sample values to units of microbars or meters per second.
9) Extra Binary and Trace header entries. All non-standard SEGY Rev. 0 Binary Header and Trace Header entries must be explained in the EBCDIC header.
10) Field recording parameters. The EBCDIC header must note the field production filters. If the field data has been filtered or gained in any way, the EBCDIC headers should note all pertinent processing parameters.

6.2 SEGY 400 Byte Binary Header

The header fields are shown in table below.

Description	Bytes	Format	Notes
Job Identification Number	3201-3204	i32	See (*) additional note
Line Number	3205-3208	i32	See (**) additional note
Tape Reel Number	3209-3212	i32	See (***) additional note
No. of data traces per record	3213-3214	i16	The number of data traces per record including dummy traces and zero traces inserted to fill out the record or file. For stacked data, there is normally one data trace per record.
No. of Auxiliary traces per record	3215-3216	i16	
Sample interval in microseconds for this line	3217-3218	i16	**Exception to standard SEGY.** The sample interval of the trace data for this line/survey only. The sample interval should be the same for all lines in a multi-line SEGY volume. (The original standard specifies this parameter as sample interval in microseconds for this volume of data).
Sample interval in microseconds for original field recording of this line/survey	3219-3220	i16	Original field recording sample interval. This value may change between lines on a multi-line SEGY volume.
Number of samples per data trace for this line/survey.	3221-3222	i16	**Exception to standard SEGY.** The number of samples per trace for this line only. The number of samples per trace should be the same for all lines in a multi-line SEGY volume. (The original standard specifies this parameter as the number of

Description	Bytes	Format	Notes
			samples per data trace for this volume of data).
Number of samples per trace (Original)	3223-3224	i16	This value may change between lines on a multi-line SEGY volume.
Data sample format code	3225-3226	i16	**Exception to standard SEGY.** The only data format accepted by Buyer for SEGY data is: DATA SAMPLE FORMAT CODE 1 (one): IBM-floating point.
Trace sorting code	3229-3230	i16	**Exception to standard SEGY.** (This is a SEGY Rev 1.0 standard). ***1 = shot ensemble***; 2 = CDP ensemble; 3 = single fold continuous profile; 4 = horizontally stacked; 5 = Common source point; 6 = Common receiver point; 7 = Common offset point; 8 = Common mid-point; 9 = Common conversion point.
Vertical sum code	3231-3232	i16	
Measurement system	3255-3256		1 = Meters, 2 = Feet
Data type	3261-3262	i16	1 = Land2D, 2 = Marine2D, 3 = Land3D, 4 = Marine3D
Coordinate flag	3263-3264	i16	0 = No coordinate in trace headers, 1 = Coordinates in trace headers
Statics flag	3265-3266	i16	0 = No statics in trace headers; 1 = Statics in trace headers
SEG Y Format Revision Number	3501-3502	i16	Must = 0 (SEGY Rev. 0

(*) Job Identification Number note:

The Job Identification Number (JIN) in bytes 3201-3204 (32-Bit Integer) shall be a unique number which allows Contractor to trace, tag or identify the seismic processing and acquisition sequences applied to the data for each line/survey. Each line/survey and process shall have a unique JIN.

(**) Line Number note:

The Line Number in bytes 3205-3208 (32-bit integer) shall be formed from the alpha-numeric line name written to card image C2 of the EBCDIC volume header by removing the alpha characters from the name and concatenating the remaining numeric characters to give an integer number.

(***) Reel numbers note:

The reel number written in bytes 3209-3212 (32-bit integer) shall be unique numbers that can be referenced by the Contractor for invoicing purposes. The unique numbers shall be documented in all transmittals, invoices and other shipping documents. The reel number for each line written to a multi-line physical output media shall be identical.

Extra Binary and Trace header entries – all non-standard SEGY Rev. 0 Binary Header and Trace Header entries must be explained in the EBCDIC header.

6.3 SEGY 240 Byte Trace Header

The header fields are shown in table below.

Description	Bytes	Format	Notes
Trace sequence number within line	1-4	I4	See note in (*) Enter Field Record Number associated with this trace. Used to merge XY info. (Not required for binned data)
Trace sequence number within reel	5-8	I4	See note in (**) Enter Field Channel or Trace Sequence Number for this Field Record. Used to merge XY info. (Not required for binned data)
Field Record identification number	9-12	I4	
Channel/Trace number within Field Record	13-16	I4	
Shot/Source Point identification number	17-20	I4	Enter Source Point Identification Number for this Field Record
Trace identification code	29-30	I2	1 = Live, 2 = Dead. See note in (***)
Data use flag	35-36	I2	1 = Production, 2 = Test
Source to receiver distance	37-40	I4	Signed distance. Enter signed source to receiver distance. NOTE: Sign is negative if opposite to direction line shot. (Required for binned data).
Source depth	49-52	I4	Enter source depth for this source point.
Water depth at source	61-64	I4	Enter water depth at this source point.
Water depth at receiver	65-68	I4	
Scalar to be applied to all elevations and depths	69-70	I2	Scalar = 0 (none), 1, ±10, ±100, ±1,000, ±10,000. If +ve, multiply; if –ve divide.
Scalar to be applied to all coordinates	71-72	I2	Scalar = 0 (none), 1, ±10, ±100, ±1,000, ±10,000. If +ve, multiply; if –ve divide.
Source X-Coordinate	73-76	I4	
Source Y-Coordinate	77-80	I4	
Receiver/Group X-Coordinate	81-84	I4	
Receiver/Group Y-Coordinate	85-88	I4	
Coordinate units	89-90	I2	1 = length in distance units 2 = seconds of arc
Weathering (Land) or water (Marine/OBC) velocity	91-92	I2	Enter water velocity for this trace
Time (msec) for sample 1	109-110	I2	= 0 (zero) if no delay. Buyer convention is that first sample time is zero if there is no delay or shift.
Number of samples in this trace	115-116	I2	Must match value in Binary Header.
Sample interval	117-	I2	In microseconds (μs)

Description	Bytes	Format	Notes
	118		
Source Line Number	189-192	I4	For un-binned data, enter 3D survey sail line number.
Receiver/Cable depth	193-196	I4	

(*) Note Trace Sequential Line Number:

For single line output data sets, the trace sequential line number starts at 1 for the first trace of the output data set and increments by 1 for each trace output. For multi-line output data sets, the trace sequential line number is reset to 1 for the first trace output to each new line, and increments by 1 for each trace output in that line.

(**) Note Trace Sequential Reel Number:

The trace sequential reel number is reset to 1 at the start of a new output volume and is incremented by 1 for each trace output to that volume.

(***) Trace Identification Code:

The trace identification codes are to be interpreted as follows: A "1" means the data on trace is valid seismic data which is to be further processed; A "2" means that data values on trace are invalid or corrupt (i.e., "bad"), or that all sample values have been set to zero. A code "2" trace is to be treated as a "dead" or zero sample value trace for processing purposes. The trace is only written to preserve any valid information in the 240 byte trace header, and to preserve a uniform number of physical traces per record/ensemble. Any invalid, or corrupt, trace header values should be corrected before writing the trace to tape. Code "2" traces are typically removed from the processing stream after the Navigation-Seismic merge stage.

6.4 SEGY Seismic Trace Data

The seismic trace data shall be in 32-bit binary IBM floating point (Big Endian). No other encoding format is acceptable to Buyer.

Not to be processed shots / bad shots – Not included in SEGY data set.

Dead and/or killed traces – Include the trace in the SEGY data set and flag the trace status in 240 byte trace header, bytes 29-30.

7 Appendix 2: Procedure for exporting a file with the coordinates of the seismic source tow point from QINSy

Exporting a file from QINSy is done as follows:

1) Copy the db file (s) of the track from which you want to export data.

2) Press Replay button in the main Qinsy window, select the file (s) you need and click the "Replay" button as on Figure 72.

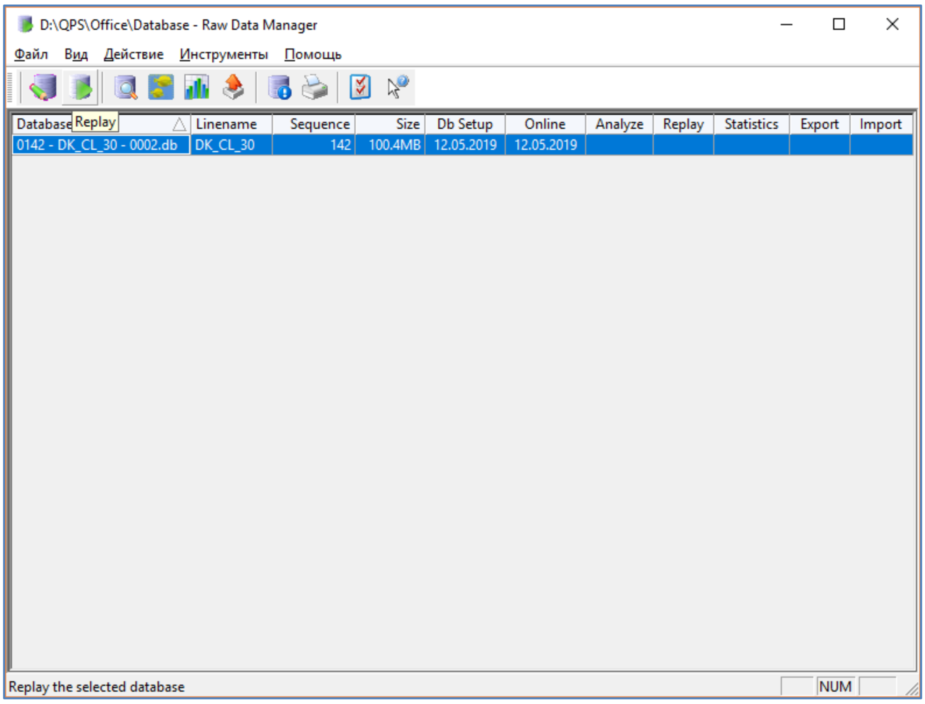


Figure 72. Window utility Replay

3) Window will be opened as on the Figure 73. Press the "Session setup" button.

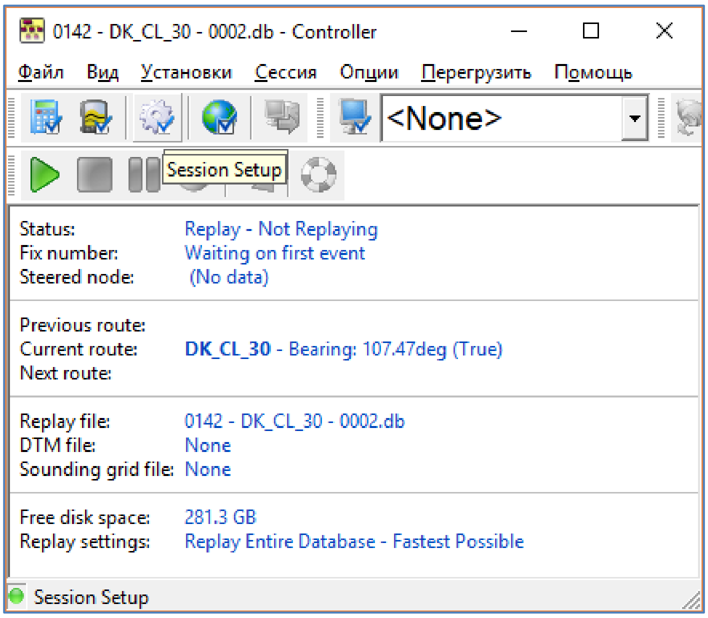


Figure 73. Window Replay controller

In the window “Session Setup” (Figure 75), go to the “Storage” tab in the left part of the window. In the section "Sounding grid" set "disabled".

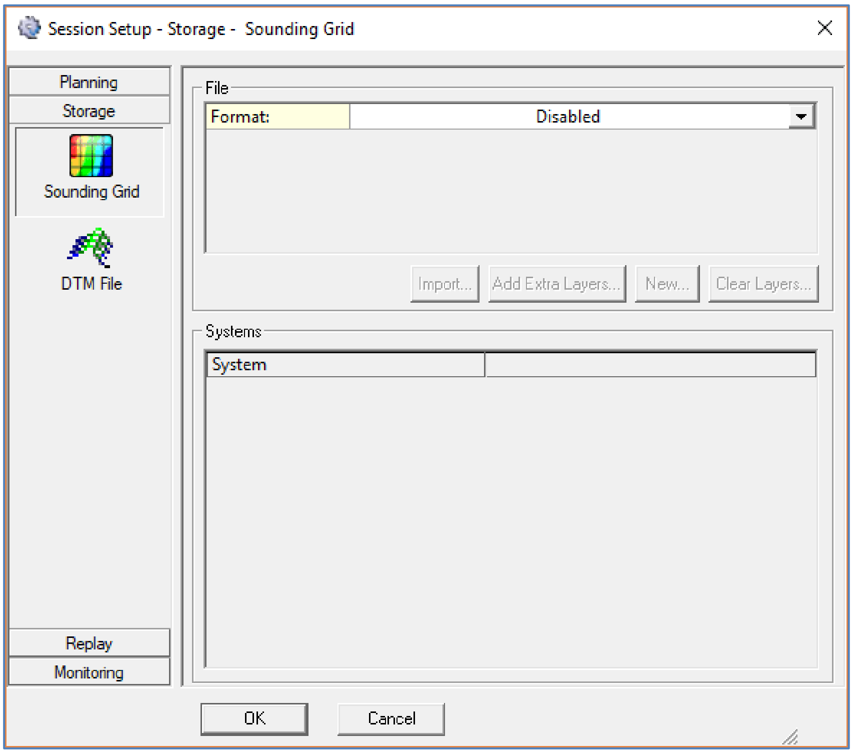


Figure 74. Menu Session Setup → Sounding grid of utility Replay

DTM File - select “*.qpd - QINSy Processing”, tick the multibeam echo sounder system (MBES). Click "Ok" (see Figure 75).

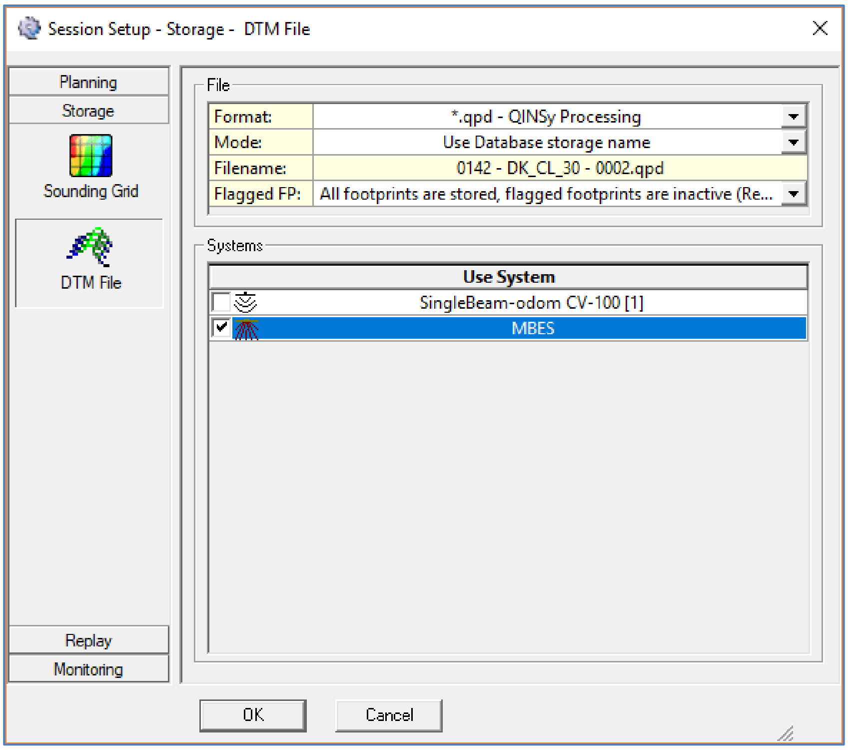


Figure 75. Menu Session Setup → DTM File utility Replay

4) In the Controller window press the "Computation Setup" button (Figure 76)

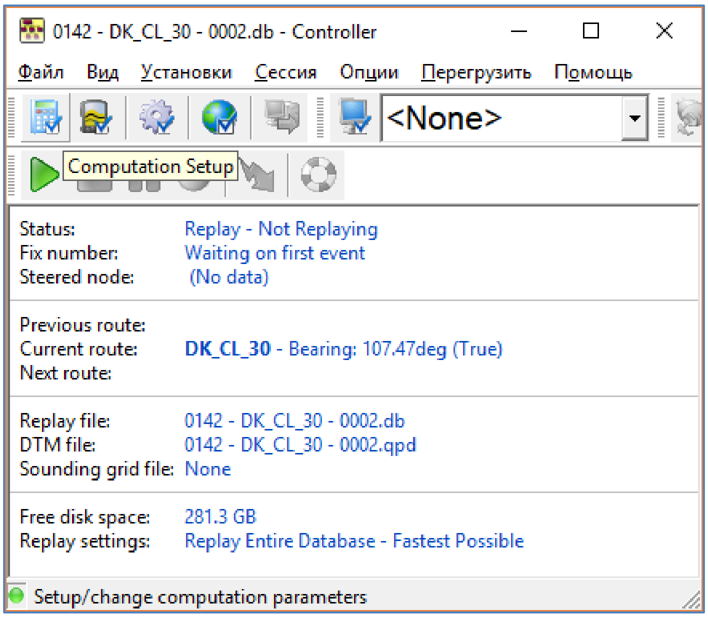


Figure 76. Window Replay controller

“Computation Setup” window will be opened like on Figure 77:

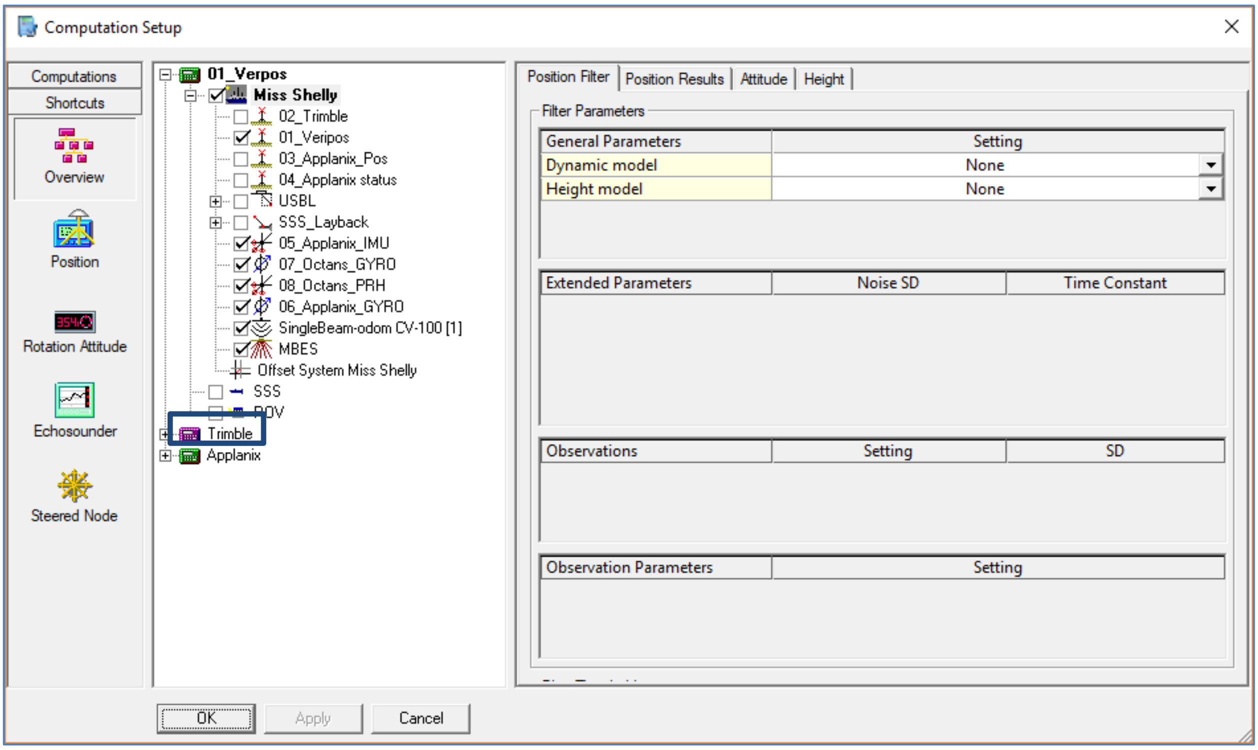


Figure 77. Window Computation Setup

The computation used during data collecting is marked by purple colour. Tick all «+» in it and click on the active positioning system (In this case “02_Trimble”).

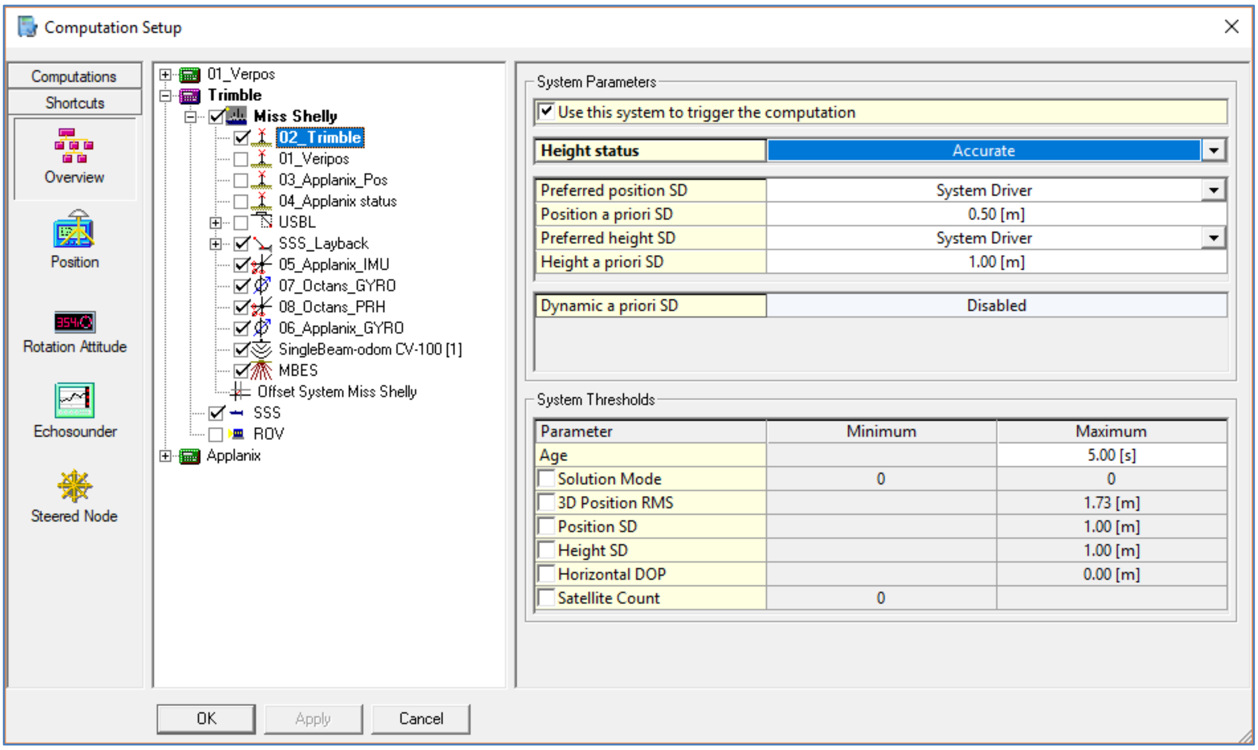


Figure 78. Positioning system of window Computation Setup

In the section “Height status” on the right side of the window: there are 2 possible options - Accurate or Unreliable. What does it mean?

A) Accurate means that the file recorded in RTK mode. Without going into details, we can say that the depths recorded in the file are automatically brought to a necessary sea level (MSL, LAT, B-77, etc.). These calculated depths are for mapping. We need the actual sea depth at the time of measurement for export. Therefore, here we need to change the value to “Unreliable”.

B) Unreliable means that the depths reduced to the actual sea level by recalculating the values of the depth using the echo sounder readings, draft sensor data and Z offsets. If you haven’t draft sensor, set the manual draft of the echo sounder and the HADR value (Height above draft reference) in the settings to 0. In this case, the ship’s CoG taken as the sea surface. (You need to put CoG of the vessel to Vessel’s water line during offsets measurement step.)

Click on the name of the vessel and check in the tab "Height": <u>**Tide method = disabled, Manual draft = 0.**</u> Click Apply and Ok. Close the controller.

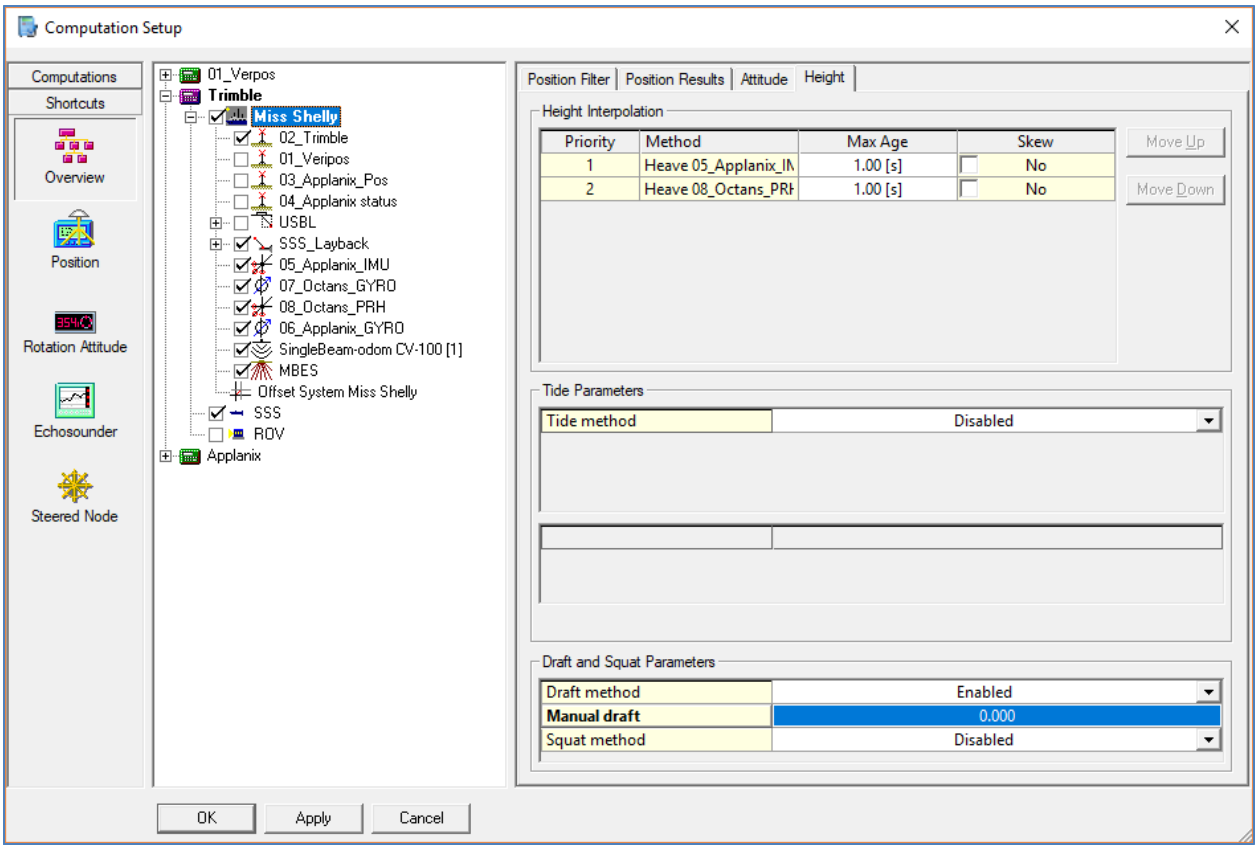


Figure 79. Window Computation Setup, tab Height

.

5) In the Replay window, select the file that we edited and click Tools → Clone settings. This command will copy settings into the remaining files, which we will specify when executing the command.

6) Select all files with the same settings and press the button . The controller opens. In the Replay controller, press the "Play" button and wait until our files overwritten with the new settings.

7) In the Replay controller, select the desired file for export (If the exported track consists of several files - the body of the name is one, and the postfix has a sequence number from 1 to n), in this case we select all the files related to this track. Click the button "Export"  → All data - Generic Export.

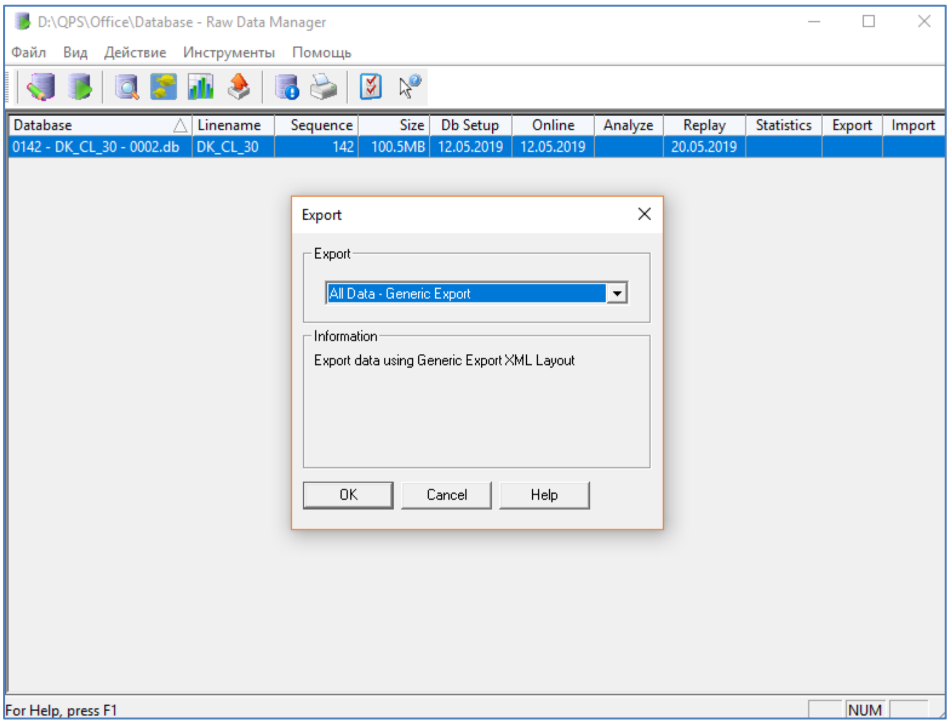


Figure 80. Window export data of utility Replay

In the next window (Figure 81) check that all Results files present and click next.

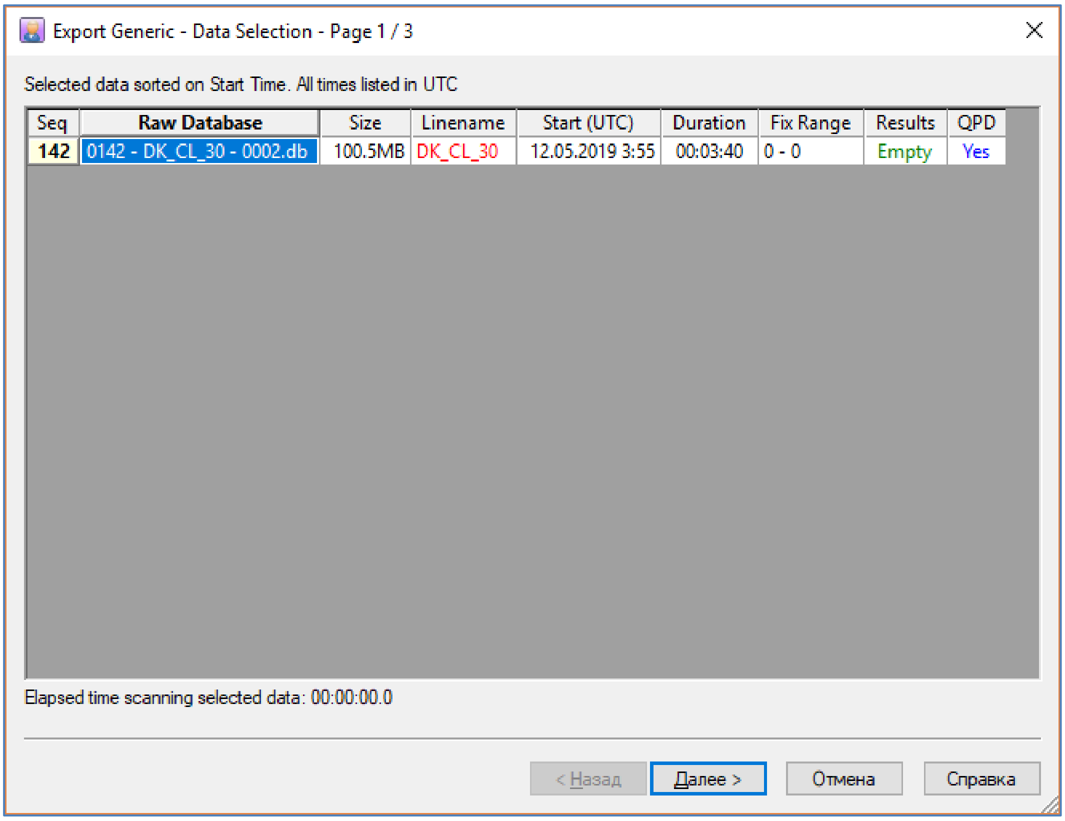


Figure 81. Window for checking the presence of errors in the files for export

In the next window create a Layout for export. In other words, a template according to which we will export necessary data in the future. Press the "New" button. A window appears, as in the Figure 82.

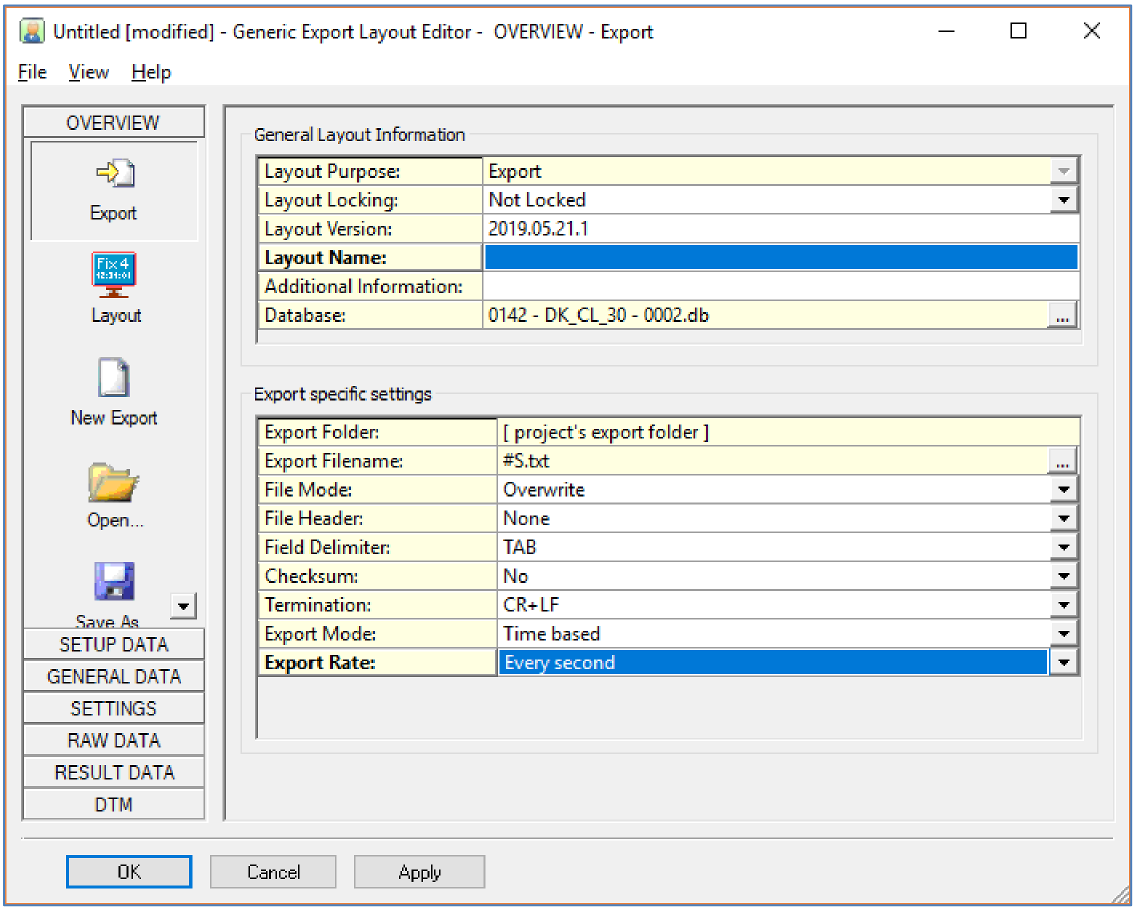


Figure 82. Window Overview → export

Here give a name to template in the field Layout name.

Export Filename: you can give the original name for the exported file or use the name of the db file.

The remaining settings should be as shown on Figure 82.

8) Click GENERAL DATA tab.

Click 2 times on the date. Reduce the date to the form in accordance with the example line: YYYYMMDD. To do this, in the Time Format field, select User Defined; in the User Defined field, press the button  and in the opened window type the characters in the Time Format Specifier line in accordance with the description given in this window below.

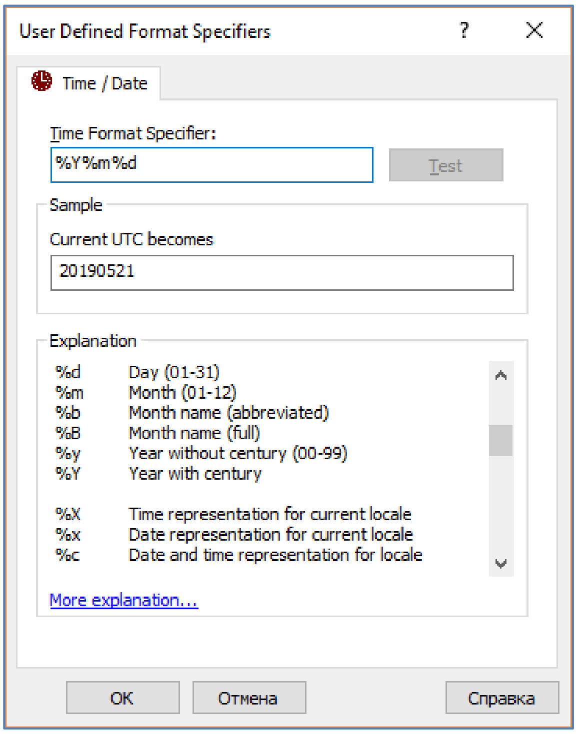


Figure 83. Window settings of format date

Time Zone: 0hr UTC.

9) Click RESULT DATA tab.

Click "Nodes". Click the "Add" button and add the towing point of the equipment for which data exporting. The point of towing equipment should be check with the on-line geophysicist.

Set Computation in which the file was recorded (it is defined in Section 4).

On the right side of the screen, select everything that you need to export to txt:

A) Time. The time format should be converted to the form specified in the data export example: hhmmss.sss. To do this, in the Time Format field, select User Defined; in the User Defined field, press the button  and in the opened window type the characters in the Time Format Specifier line in accordance with the description given in this window below.

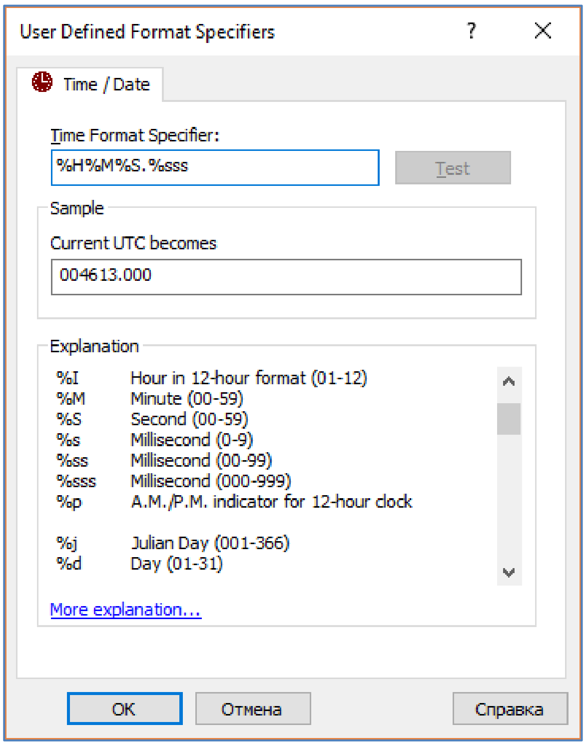


Figure 84. Window settings of format time

Time Zone: 0hr UTC.

B) Easting. Check that Nr Format = x.xx

C) Northing. Check that Nr Format = x.xx

D) Heading. Check that Nr Format = x.xx

Click to Apply.

10) Click to the tab Overview → layout. Check that the sequence of lines corresponds to Figure 85.

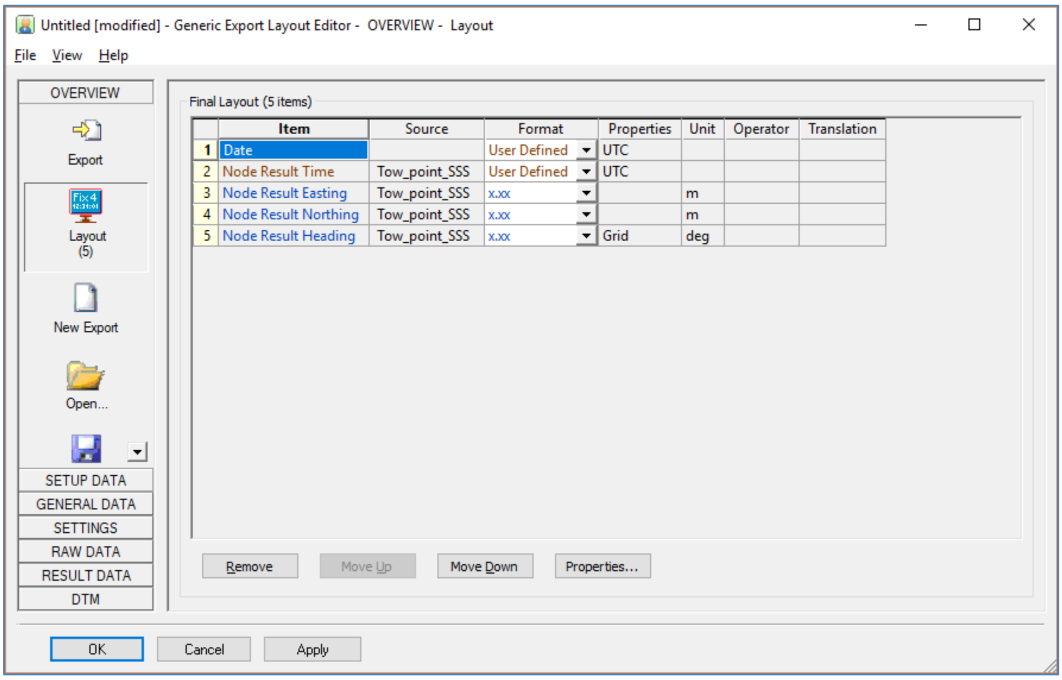


Figure 85. Window Overview → Layout

If the line is not in true place, it can be lifted or lowered using the “Move Up” and “Move Down” buttons.

The setup of data export template completed. Click to Apply and Ok.

11) After saving the Layout, the program returns to the Layout selection window. Put a tick in front of created Layout and click Next → Finish (Figure 86).

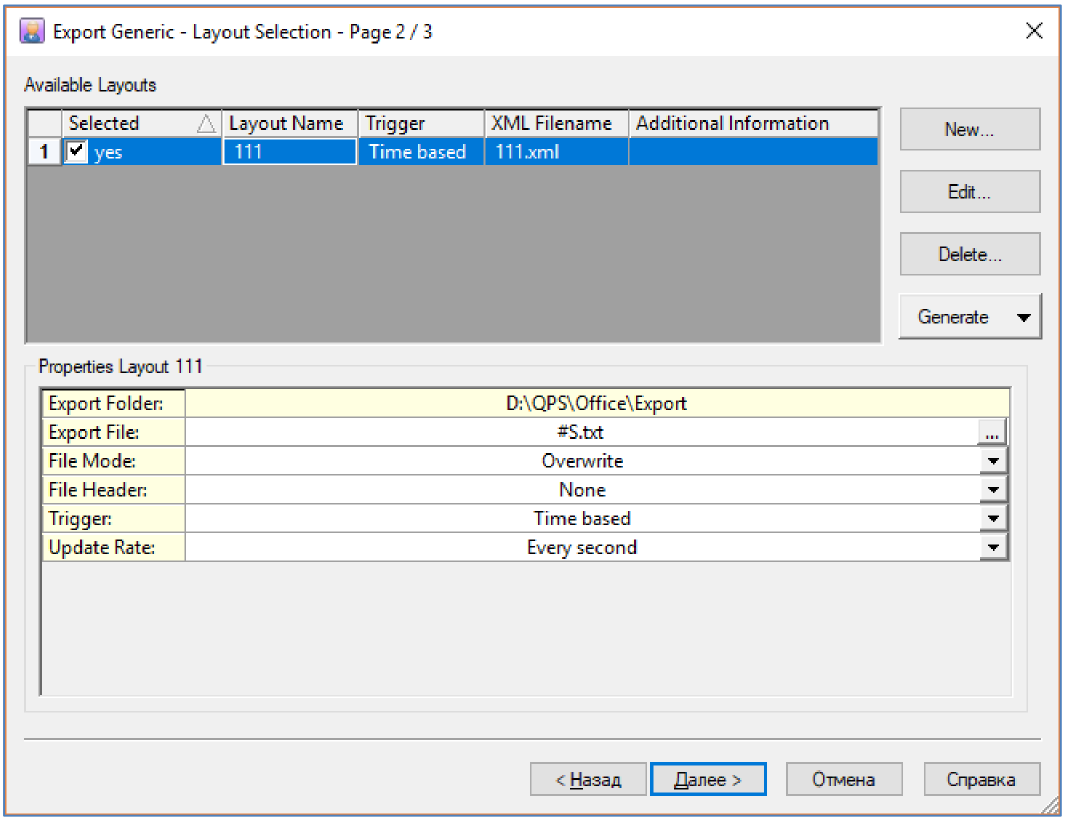


Figure 86. Window of export data

The file export completed. The exported file can be found in the Export folder of the QINSy project and handed over to the geophysicist-processor.

8 Appendix 3: The procedure for exporting a file with coordinates and depths along the MBES rays from QINSy

To export a file, do the following:
1) Pass to the Processing Manager (Survey Manager in newest Qinsy versions). When enter it, a dialog box appears with a choice of the type of project (Figure 87). Choose "Empty Session".

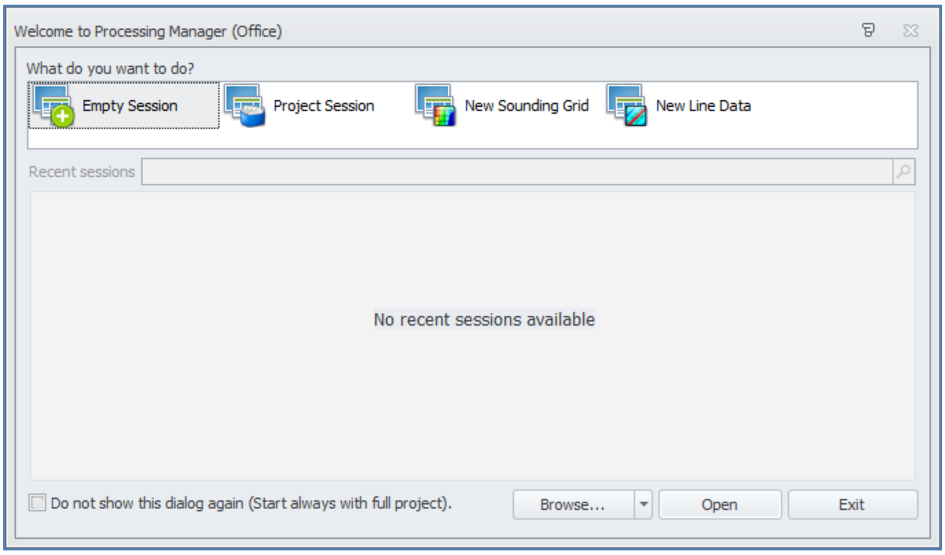


Figure 87. Choosing a way to open Processing Manager

Import here overwritten qpd files. To do this, right-click on the “Survey files” → Import → Survey (Figure 88).

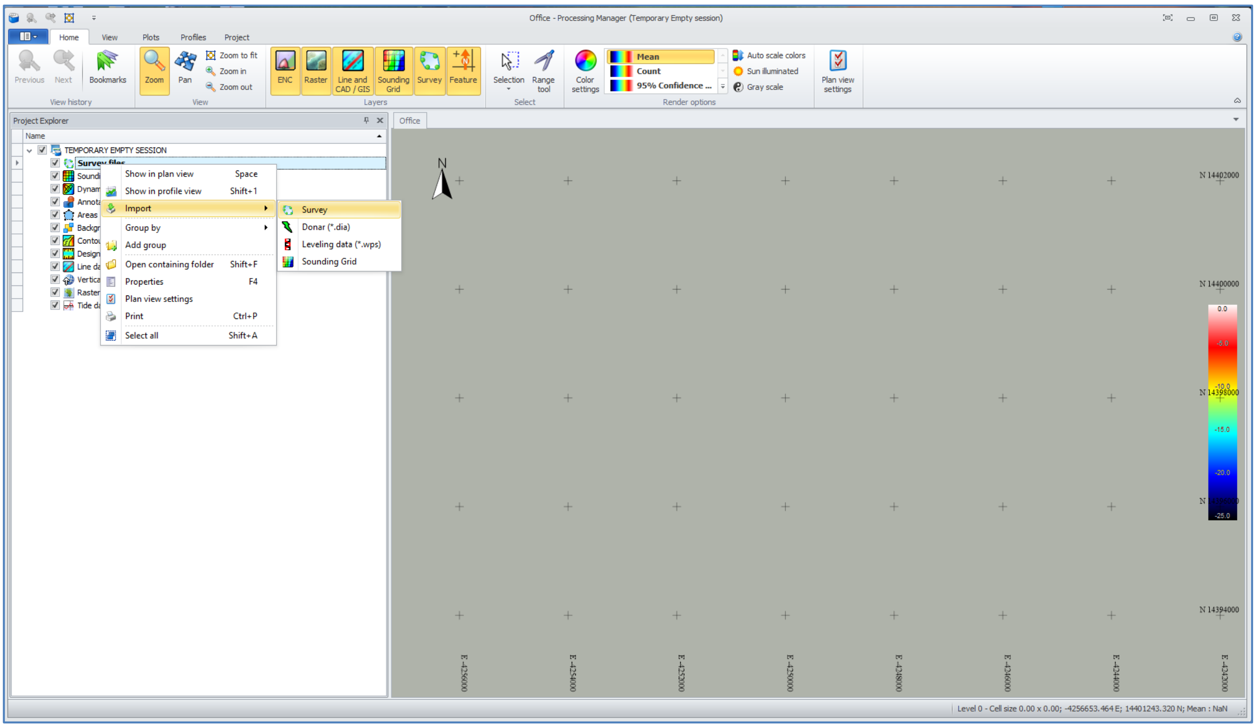


Figure 88. Import QPD files

In the window that opens, select the qpd files.

2) Earlier it was said that in the Unreliable mode, the depths recorded with the condition that the vessel’s COG is on the surface of the water. In fact, the ship’s COG is not always on the surface. In order to determine the correction to bring the depth to the actual sea level, we need to export the vessel’s draft sensor data for the entire tack recording period and calculate the average value. Further, using the formula, determine the depth correction and apply it in the Validator by shifting the depth points to a constant value.

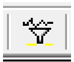
Sensor draft data is also exported via Export. → All data – Generic Export of Replay utility. Create a new Layout, find the Draft Sensor in the Raw Data → Observation Systems tab and select Value for export. Make export for all files in the tack.
Because The vessel’s draft sensor is located near a multibeam echo sounder, the sea level offset from to the vessel’s COG can be calculated using the following formula

$$\Delta D = Z_{draft} + Draft_{cp}, \text{ where:}$$

ΔD - offset of actual sea level over calculated in QINSy. The “+” sign means that the actual sea level is higher than calculated; “-” means that the actual sea level is lower than the calculated by QINSy.
Z_{draft} is the offset of the vessel's draft sensor along the Z axis in the ship's coordinate system. It can be taken from the db settings.
$Draft_{cp}$ is the average value of the vessel draft sensor for the entire tack. Calculated from the export of vessel’s draft sensor data.

When using the formula, the signs do not change. Z offset of draft sensor, as a rule, a negative value; the “Draft” value of the vessel draft sensor always a positive.

3) The calculated offset must be entered into the data. To do this, select the necessary files in the Survey files section in the Processing Manager, go to the Edit tab, click the “Validator” button 

. In the left part of the window, activate all the lines (put a checkmark in front of all files). After that, press the button  , behind button  → All footprint (all spots of illumination). A window will be opened as on Figure 89.

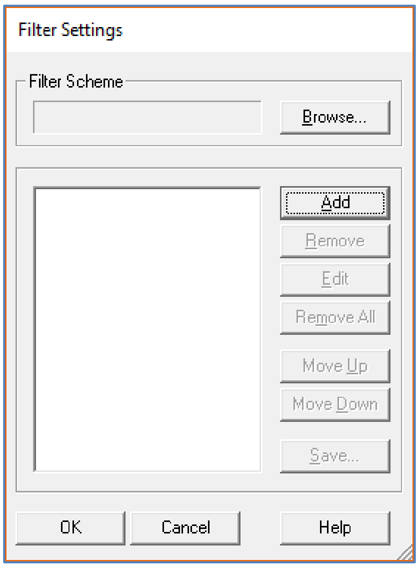


Figure 89. Window for adding commands editing points

Click to Add, select to “Shift [Z]” from the drop-down list - a window will be opened as on Figure 90.

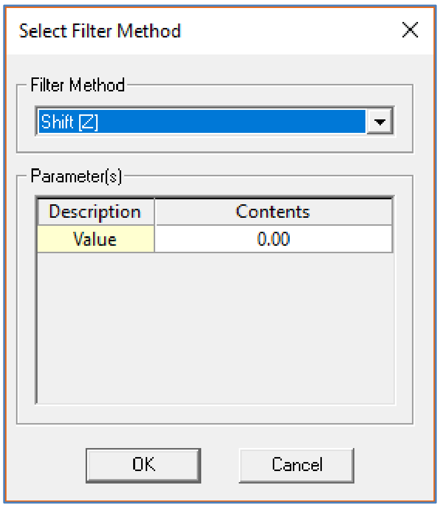


Figure 90. Window settings command «Shift [Z]»

Here enter the value of the calculated offset and click Ok. The program will begin to recalculate the depths.

4) The QPD file should be cleaned from gross errors. It is possible to do here, in Validator. The principle of data clearing by the Validator program can be found in the “Help” section of QINSy.

5) After cleaning the data, save and close the Validator. Select the necessary files in the Survey files section of the Processing Manager (here can be present files for several tracks, select only files corresponding to one track), right-click on the selected files and click Export → User defined ASCII (Figure 91).

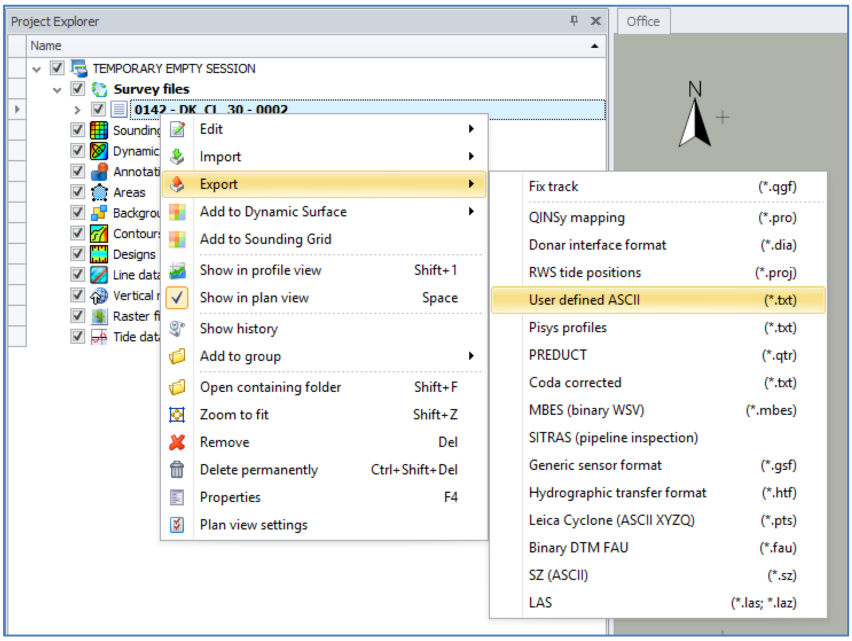


Figure 91. Export data from QPD files

Window will be opened as on Figure 92:

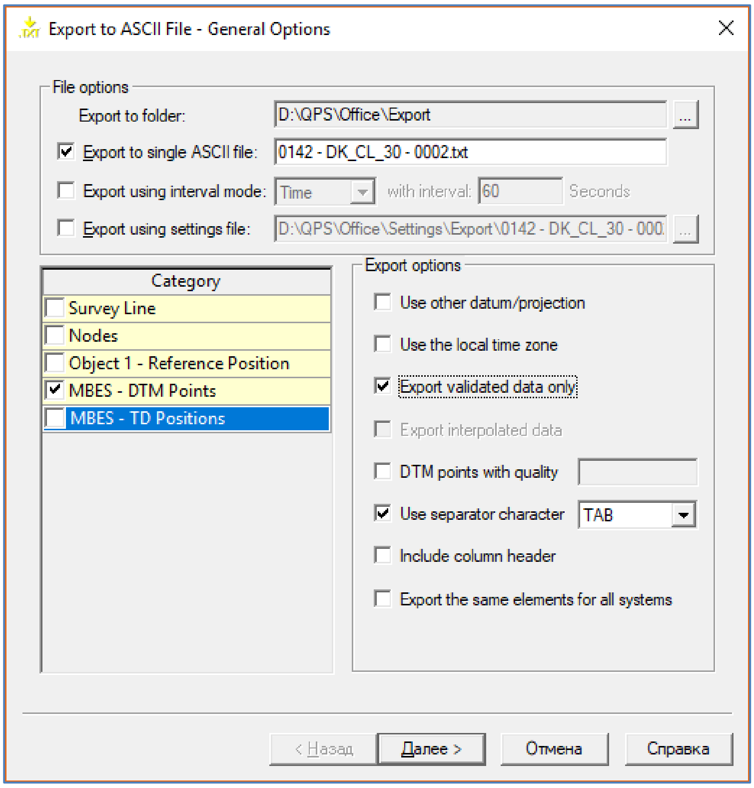


Figure 92. Window settings of export data from QPD files

In the field “Export to single ASCII file” enter the name of the exported file. ***ATTENTION: This name does not automatically change when changing files from which data exported! Do not forget to enter the current file name each time to avoid confusion in case of large export volumes.***

The fields should be enabled and setted as shown on Figure 92.

Click to Next button. Window will be opened as on Figure 93.

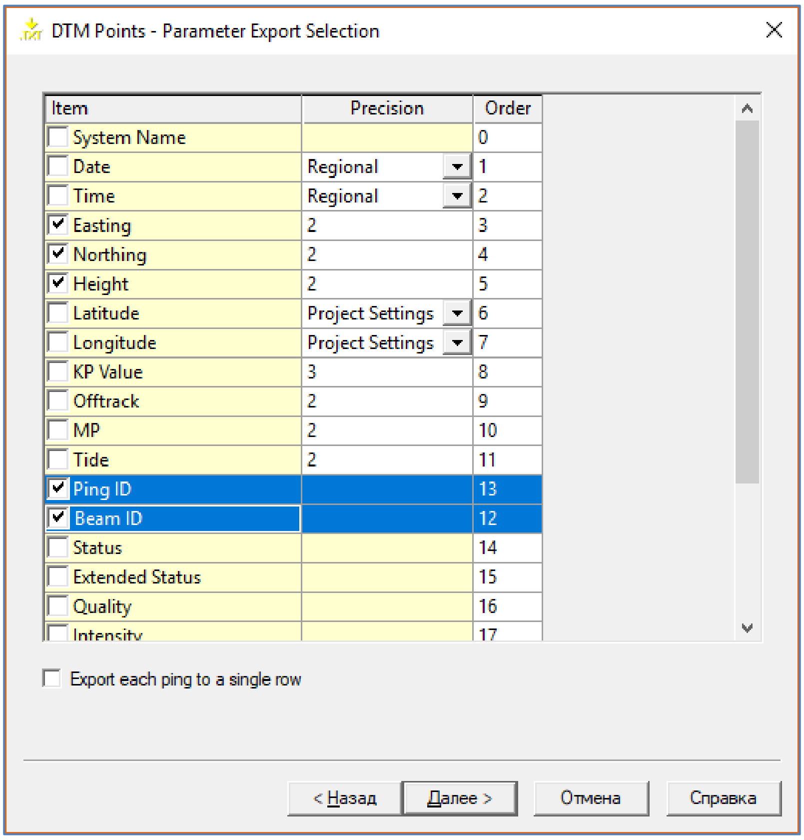


Figure 93. Window settings fields of export data from QPD files

Note that in the “Order” column, the Ping ID field corresponds to 13, and the Beam ID field corresponds to 12. There is done intentionally, since in the exported file, the Beam ID column is in front of the Ping ID column.

Click to Next button and the file exported to the QINSy Export folder. The file should be transferred to the geophysicist-processor.