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RTK Tides in HYPACK

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To understand the RTK (Real Time Kinematic) tide method in HYPACK® could be a lengthy conversation. This document is a quick review of how it works and how it is designed.

GEODESY

First the geodetic parameters must be configured to correctly compute the tide. Without going into too much detail the following image shows the geodesy used in this testing example.

GEODETIC PARAMETERS

The screenshot shows the 'Geodetic Parameters' dialog box with the following settings:

- Predefined:**
 - Grids: State Plane NAD-83
 - Zone: CT-0600 CONNECTICUT
- Distance Unit:** US Survey Foot
- Depth Unit:** same as horizontal
- ☐ Elevation Mode (Z-axis positive going up)
- Ellipsoid:** WGS-84
 - Semi-Major Axis: 6378137
 - Flattening: 298.257223563
- Datum transformation parameters:**
 - Delta X: 0.000, Delta rX: 0.00000
 - Delta Y: 0.000, Delta rY: 0.00000
 - Delta Z: 0.000, Delta rZ: 0.00000
 - Delta Scale: 0.00000
 - Datum shift file: (empty)
- Projection:** Lambert Conformal Conical
 - Central Meridian: 072 45 0 W
 - Reference Latitude: 40 50 0 N
 - Scale Factor: 1
 - North Parallel: 41 52 0 N
 - South Parallel: 41 12 0 N
 - False Easting: 1000000
 - False Northing: 500000
 - ☐ Local Grid Adjustment (Local Grid button)
- RTK Tide Method:**
 - ☐ Not using RTK tide
 - ☐ (K-N) from KTD file
 - ☐ N from geoid model, K from KTD file
 - ☐ N from geoid model, K from VDatum
 - ☒ N from geoid model, K from user value
 - ☐ (K-N) from user value
- Geoid Model:** g2012b-CONUS
- Orthometric Height Correction:** 0.000 ftUS
- Height of geoid above chart datum:** 0.00

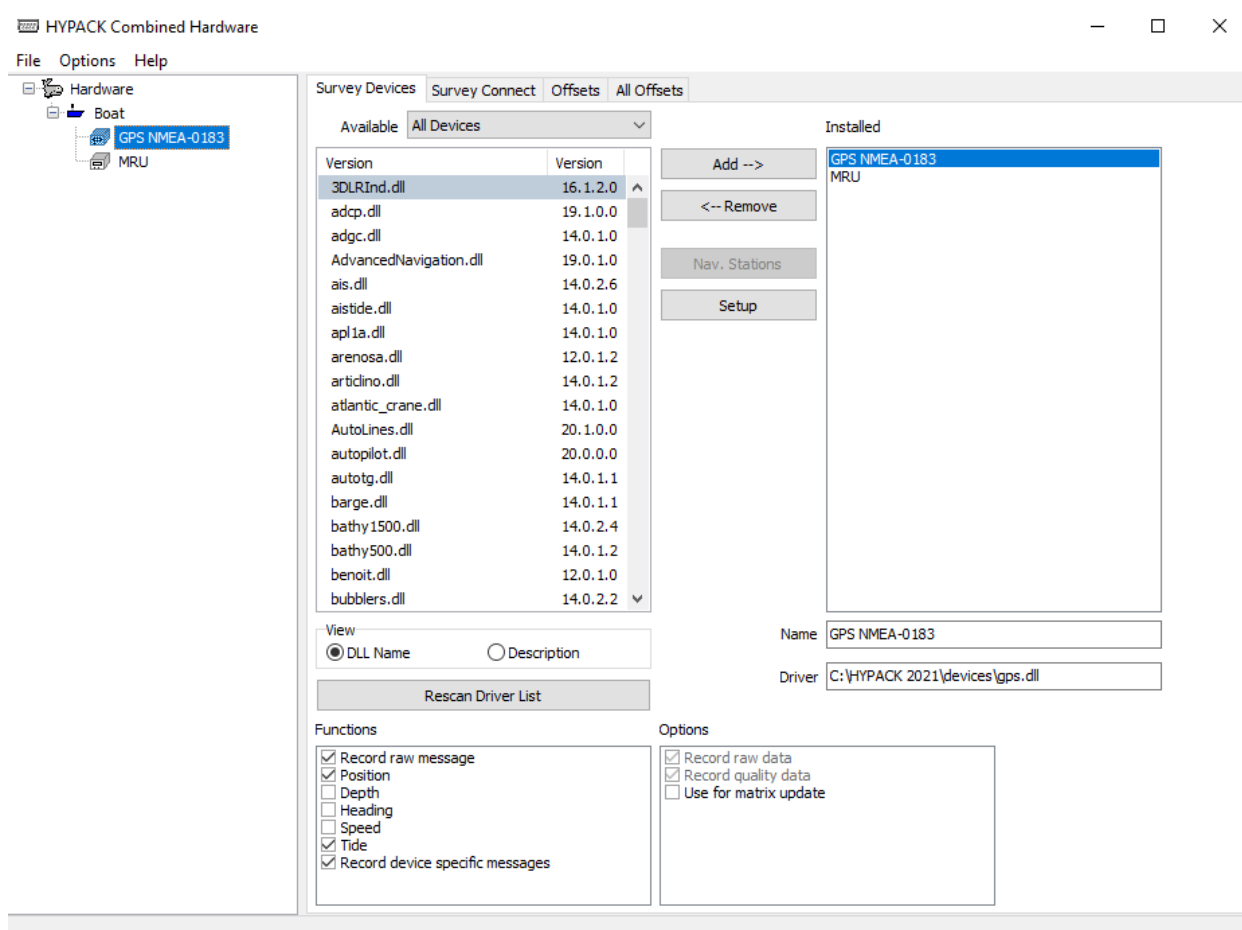
Buttons: OK, Cancel

The geodsy configuration provides the information the positioning driver needs to calculate a proper tide. In this case, the geoid model provides the undulation used in the calculations.

HARDWARE

In our simulation, the GPS read a simulated GGA string in RTK Fixed quality to simulate a position that did not waiver. The following image shows the HARDWARE setup.

HARDWARE Configuration for RTK Tides



REAL-TIME SURVEY MODE

In the HYPACK® SURVEY program, the tide is pitch and roll corrected in the display. In the following figures, the first image shows the GPS string without pitch and roll correction:

Tide is 80.35 with no Pitch and Roll Applied.

No Pitch and Roll Applied

The screenshot shows the 'Survey' application window. The 'GPS NMEA-0183-X\GGA.txt' panel displays the following data:

General	Value
Mode	Fixed RTK
Lat	41°16.6374 N
Lon	072°05.8000 W
Easting	1179580.90
Northing	662438.99
Tide Corr	80.35 fms
Speed	N/A
Depth	N/A
Heading	N/A
Time source	computer
Sync Error	N/A

The 'Data Display(1)' panel shows the following data:

Value	
East	1179580.90
North	662438.99
Pitch	0.000
Roll	0.000
Tide	80.35

The 'MRU-' panel shows the 'Basic Controls' section with a 'HEADING' slider set to 000.0 and a 'Depth' slider set to 0.00. The 'Motion Reference' section shows 'Pitch', 'Roll', and 'Heave' sliders, all set to 0.00.

Tide 55.02 with 41.7 degrees of Pitch.

41.7 Degrees of Pitch

The screenshot shows the 'Survey' application window. The 'GPS NMEA-0183-X\GGA.txt' panel displays the following data:

General	Value
Mode	Fixed RTK
Lat	41°16.6374 N
Lon	072°05.8000 W
Easting	1179580.90
Northing	662438.99
Tide Corr	55.02 fms
Speed	N/A
Depth	N/A
Heading	N/A
Time source	computer
Sync Error	N/A

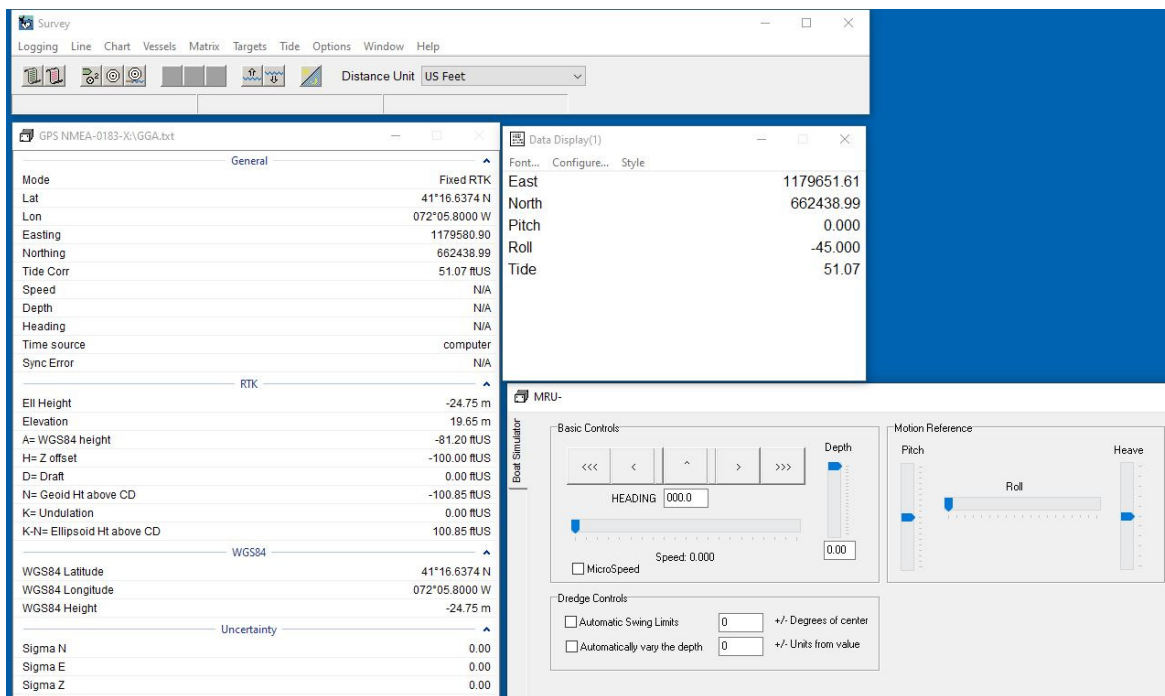
The 'Data Display(1)' panel shows the following data:

Value	
East	1179580.90
North	662505.51
Pitch	41.700
Roll	0.000
Tide	55.02

The 'MRU-' panel shows the 'Basic Controls' section with a 'HEADING' slider set to 000.0 and a 'Depth' slider set to 0.00. The 'Motion Reference' section shows 'Pitch', 'Roll', and 'Heave' sliders, with 'Pitch' set to 41.7 and 'Roll' and 'Heave' set to 0.00.

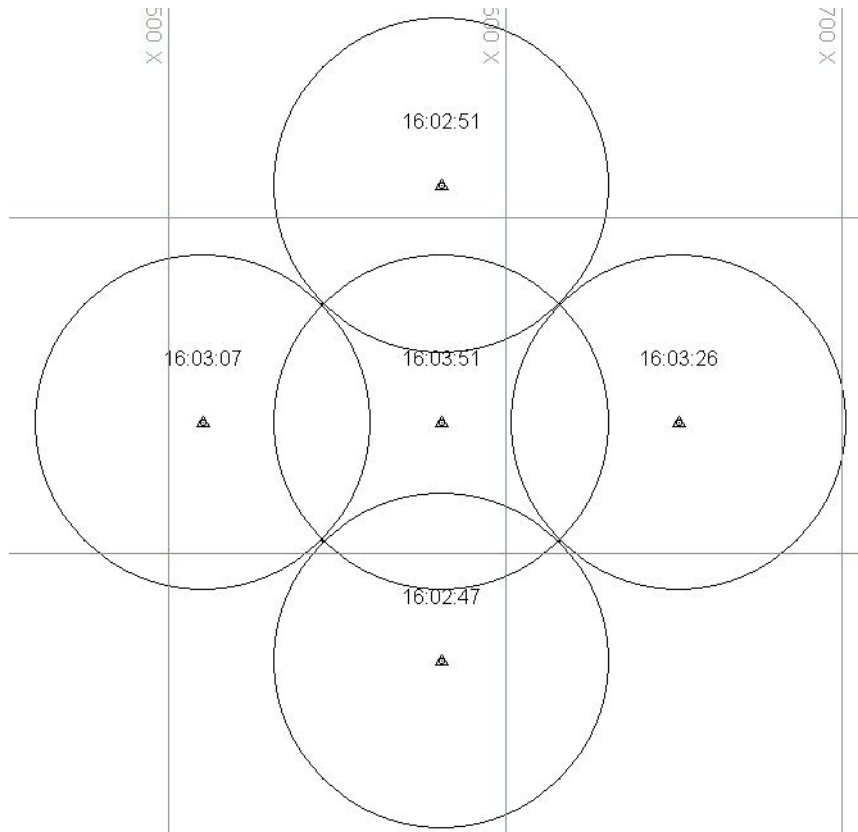
Tide 51.07 with -45 degrees of Roll.

-45 degrees of Roll



Targets were marked with full pitch and roll applied first 45 degrees one way, then 45 degrees the other.

Targets with 45 Degree Pitch and Roll Corrections in Either Direction



RTK TIDES IN THE RAW FILE

In the RAW file, the tide is recorded without any pitch or roll correction. This is the raw tide with vertical offset.

The KTC record has all of the parameters used to compute the tide of -80.355 with no pitch or roll.

Sample Data

```
TID 0 57718.168 80.355
KTC 0 57718.168 11 -81.201 -81.201 -100.846 0.000 -100.000 0.000 -
80.355 0.000 0.000 0.000 4.000
HCP 1 57718.608 0.000 0.000 0.000
```

In the following figure, we see that when there is pitch and roll, the KTC record changes. The value that was recorded in the TID record is without pitch and roll, but the value that is in the KTC record shows pitch and roll applied.

TID Records Raw Tide, While KTD Records Corrected Tide

```
TID 0 57738.188 80.355
KTC 0 57738.188 11 -81.201 -81.201 -100.846 0.000 -100.000 0.000
-80.123 0.000 -390.000 0.000 4.000
HCP 1 57738.620 0.000 -3.900 0.000
```

The RAW information is stored in the files. The editor has the option to apply the pitch and roll to the RTK if the user selects RTK tides.

RTK TIDES IN THE SINGLE BEAM EDITOR

In the original 32-bit editor for Single Beam Data, the option to choose RTK Tides is in the Advanced tab of the Read Parameters . When this is not checked the tide has vertical offset applied, but no pitch and roll as it was stored in the RAW file.

RTK Tides Method is Unselected

Single Beam Max - RAW01272021.LOG

File Edit View Tools Help

1 - 0000_1601.RAW

Spreadsheet

Fill Column Swap Depth 1,2 Export Highlights

Record	Time	Raw Depth 1	Tide Corr	Corr. Depth 1
1	16:01:58.49	0.00	80.36	80.36
2	16:01:58.60	0.00	80.36	80.36
3	16:01:58.70	0.00	80.36	80.36
4	16:01:58.82	0.00	80.36	80.36
5	16:01:58.92	0.00	80.36	80.36
6	16:01:59.03	0.00	80.36	80.36
7	16:01:59.14	0.00	80.36	80.36
8	16:01:59.26	0.00	80.36	80.36
9	16:01:59.36	0.00	80.36	80.36
10	16:01:59.47	0.00	80.36	80.36
11	16:01:59.58	0.00	80.36	80.36
12	16:01:59.69	0.00	80.36	80.36
13	16:01:59.80	0.00	80.36	80.36
14	16:01:59.91	0.00	80.36	80.36
15	16:02:00.02	0.00	80.36	80.36
16	16:02:00.12	0.00	80.36	80.36
17	16:02:00.24	0.00	80.36	80.36
18	16:02:00.34	0.00	80.36	80.36
19	16:02:00.45	0.00	80.36	80.36
20	16:02:00.56	0.00	80.36	80.36
21	16:02:00.67	0.00	80.36	80.36
22	16:02:00.78	0.00	80.36	80.36
23	16:02:00.89	0.00	80.36	80.36
24	16:02:01.00	0.00	80.36	80.36
25	16:02:01.12	0.00	80.36	80.36
26	16:02:01.22	0.00	80.36	80.36
27	16:02:01.33	0.00	80.36	80.36
28	16:02:01.44	0.00	80.36	80.36

Read Parameters

Selections Offsets Survey Info Presort GPS Pre-Filter Advanced

RTK GPS

- ☐ Recalculate RTK Tides Using Project Geodesy
- ☐ RTK Tide Method
- ☒ Average Tide Data to Remove Heave (Recommended)
Averaging Period (Seconds) 30
- ☐ Merge Tide Data with Heave
- ☐ Experimental Method
 - ☒ Depth Below Transducer
 - ☐ Depth Below Surface

MRU

- ☒ Apply Heave Correction
- ☒ Apply Pitch and Roll Corrections
- ☐ Remove Heave Drift
- ☒ Steer Sounding Beam
- Averaging Period (Seconds) 12
- Beam Angle (Degrees) 3

POSPac

- ☐ POSPac Adjustments Configuration

Post-Processed GPS Correction

- ☐ Use Post-Processed GPS Correction File Configuration

OK Cancel

When the RTK Method option is checked, the pitch and roll are applied to the RTK tides. Notice in the previous image the tide was 80.36, and in the following image it is 59.56. The only difference is that the RTK Tide Method was selected so the pitch and roll are applied.

The screenshot displays the 'Single Beam Max - RAW01272021.LOG' application window. The main window shows a 'Spreadsheet' tab with a table of depth data. The table has columns: Record, Time, Raw Depth 1, Tide Corr, and Corr. Depth 1. The data shows a series of depth measurements over time, with the 'Tide Corr' column showing values around 59.56 to 61.64. A 'Read Parameters' dialog box is open, showing the 'Advanced' tab. The 'RTK GPS' section is highlighted with a red box, showing the 'RTK Tide Method' checkbox checked. The 'Average Tide Data to Remove Heave (Recommended)' radio button is selected, with an 'Averaging Period (Seconds)' of 30. The 'MRU' section shows 'Apply Heave Correction' checked, and 'Apply Pitch and Roll Corrections' checked. The 'Post-Processed GPS Correction' section shows 'Use Post-Processed GPS Correction File' unchecked.

Record	Time	Raw Depth 1	Tide Corr	Corr. Depth 1
1	16:01:58.49	0.00	59.56	59.56
2	16:01:58.60	0.00	59.49	59.49
3	16:01:58.70	0.00	59.43	59.43
4	16:01:58.82	0.00	59.37	59.37
5	16:01:58.92	0.00	59.32	59.32
6	16:01:59.03	0.00	59.26	59.26
7	16:01:59.14	0.00	59.20	59.20
8	16:01:59.26	0.00	59.15	59.15
9	16:01:59.36	0.00	59.09	59.09
10	16:01:59.47	0.00	59.23	59.23
11	16:01:59.58	0.00	59.38	59.38
12	16:01:59.69	0.00	59.52	59.52
13	16:01:59.80	0.00	59.66	59.66
14	16:01:59.91	0.00	59.79	59.79
15	16:02:00.02	0.00	59.93	59.93
16	16:02:00.12	0.00	60.06	60.06
17	16:02:00.24	0.00	60.19	60.19
18	16:02:00.34	0.00	60.32	60.32
19	16:02:00.45	0.00	60.45	60.45
20	16:02:00.56	0.00	60.58	60.58
21	16:02:00.67	0.00	60.70	60.70
22	16:02:00.78	0.00	60.82	60.82
23	16:02:00.89	0.00	60.95	60.95
24	16:02:01.00	0.00	61.06	61.06
25	16:02:01.12	0.00	61.18	61.18
26	16:02:01.22	0.00	61.30	61.30
27	16:02:01.33	0.00	61.41	61.41
28	16:02:01.44	0.00	61.53	61.53
29	16:02:01.55	0.00	61.64	61.64

RTK TIDES IN THE SMBAX64 OR MBMAX64

The same applies to the 64-bit editors, but the checkbox is in a different location. In the Read Parameters dialog, click [Edit] in the Device Selection tab. The Tide area has a checkbox to apply RTK Tides. If this is checked, pitch and roll apply.

Applying Pitch and Roll Corrections in the 64-bit Editors

SBMAX64 - RAW01272021.LOG - Depth

File Edit View Tools Help

Survey Files

Draw Selected Files Only

Select All

1 - 0000 - 1601.RAW*

Edit

Soundings

Tracklines

Show

Charts

Color Bar

Flags

Targets

Tracklines

Soundings

Planned Lines

Event

Style

Numeric

Depth Selection

Edit Mode = Soundings, MaxBeams = 2

Color By Depth

0

Spreadsheet - Depth

Hide Panel

Fill Column

Fill Selection

Swap Depth 1,2

Export

Read Parameters

Survey Corrections Devices Processing

Display Options

COG

Corr. Depth 1

Corr. Depth 2

Date

DBL

DOL

Dop

Draft Corr

Epoch

Event

GPS Elevation

Time

Tide Corr

	Time	Tide Corr
433	16:02:45.743	61.85
434	16:02:45.847	61.96
435	16:02:45.959	62.08
436	16:02:46.072	62.20
437	16:02:46.177	62.31
438	16:02:46.285	62.42
439	16:02:46.396	62.54
440	16:02:46.506	62.66
441	16:02:46.620	62.78
442	16:02:46.722	62.89
443	16:02:46.836	63.01
444	16:02:46.942	63.12
445	16:02:47.052	63.24
446	16:02:47.160	63.35
447	16:02:47.269	63.47
448	16:02:47.423	63.63
449	16:02:47.493	63.71
450	16:02:47.599	63.82
451	16:02:47.709	63.94
452	16:02:47.822	64.06
453	16:02:47.927	64.17
454	16:02:48.035	64.28

Device Offsets

Navigation

GPS NMEA-0183

Starboard

0.00

Vertical

-100.00

Forward

0.00

Latency

0.000

MRU

MRU

Starboard

0.00

Pitch

0.00

Forward

0.00

Roll

0.00

Vertical

0.00

Latency

0.000

Special Cases...

Heading

No Heading Device

Yaw

Latency

Tide

GPS NMEA-0183

☒ RTK Tides

Starboard

0.00

Vertical

-100.00

Forward

0.00

Latency

0.000

Sonar

MRU

MRU

Starboard

0.00

Yaw

0.00

Forward

0.00

Pitch

0.00

Vertical

0.00

Roll

0.00

Latency

0.000

Multiple Transducers...

OK

Cancel

OK

Cancel

Apply

Z Scale = 1.0

View Angle 0.0

16:02:45.743

Depth 1

X=1179580.90

Y=662368.28

Z=61.85

DBL=-70.71