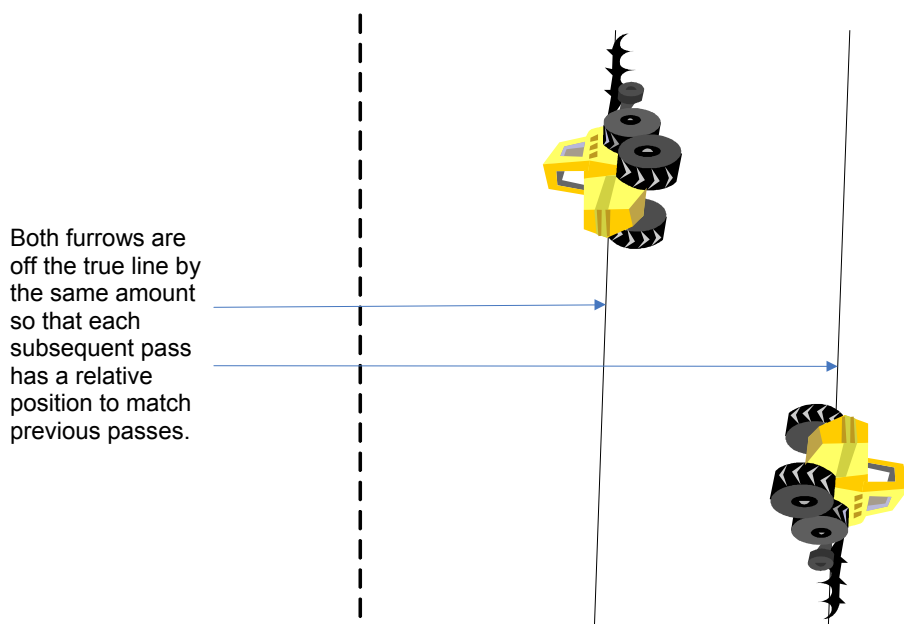# Application Note on Pass to Pass Mode

Introduction

This application note includes background information on the Pass to Pass mode and general guidance on how to use it.

About Pass to Pass Mode

The Pass to Pass mode[1] is a method of pseudorange smoothing to keep solutions lined up. This results in better relative positions over short time periods. Pass to Pass mode is most applicable for machine guidance applications and is typically used with RTK positioning. For an example, see the figure below.

Both furrows are off the true line by the same amount so that each subsequent pass has a relative position to match previous passes.

Figure 1: Pass to Pass Mode Example

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[1] Version 3.210 of the OEMV firmware includes the PDP (pseudorange/delta-phase) filter, another solution smoother. For the smoothest solution, try using both the Pass to Pass mode and the PDP filter.

Test Results

This section describes investigation testing performed on the OEMV family of receivers in Pass-to-Pass mode with 3.100 software. These tests were done on a rooftop in a static environment. Data was collected for 24 hours, then post-processed for various pass time intervals. All of the data was collected with the following command filter settings:

```
PASSTOPASS enable on on default 1.0.
```

Data processing starts by computing the cross-track error, relative to a N-S line for each point, in the data set. For the 15 minute time interval, the RMS (root mean square) cross-track error is calculated using each of the 900 points in one pass. The same thing is done for the second pass and so on. Once this is caluculated, there is a single value that can be used to represent each pass in the field. To evaluate how much variability there is between passes, the single value from each pass is differenced with the previous pass. The overall pass to pass error is calculated as the mean of the absolute value of these differences. The test results reveal how much the horizontal position changes over the short time interval, not how much it changes over the entire data set. All the results in Table 1 and Table 2 are for the horizontal RMS. These results are from using a 15 minute pass interval in post-processing.

Table 1 contains results from tests with an OEMV with L1 only and Pass to Pass smoothing enabled.

Table 1: OEMV with L1

Test	Number of Passes	Pass to Pass RMS Accuracy (m)
WAAS L1 only	95	0.14
CDGPS L1 only	95	0.14
OmniSTAR VBS	95	0.13

Table 2 contains the results from tests with an OEMV3 with L1 and L2 and Pass to Pass smoothing enabled.

Table 2: OEMV3 with L1 & L2

Test	Number of Passes	Pass to Pass RMS Accuracy (m)
WAAS L1/L2	95	0.12
DGPS	95	0.16
RTK	95	0.015
CDGPS L1/L2	95	0.13
OmniSTAR VBS	95	0.1
OmniSTAR HP	95	0.03
OmniSTAR XP	95	0.03

Pass to Pass Command

This command is available on all OEMV-based products with 3.100 firmware or higher.

Command: `PASSTOPASSMODE`

PASSTOPASSMODE Enable/disable solution smoothing modes

This command allows you to enable or disable different solution smoothing modes. The command filters include the following:

Command Filters:

- Pass to Pass smoothing (enable/disable)   - enabled by command default
- Deweight passtopass (off/default/low/high) - default by default
- Deweight scale   - command default -1.0

The command is disabled by factory default[2]. You may decide to use it if you want to obtain a smoother solution. In this case, NovAtel advises that you use the recommendations shown in the example and table that follow.

Abbreviated ASCII Syntax: **Message ID: 601**

```
PASSTOPASSMODE [switch] [measmth] [corrsmth] [deweight] [scale]
```

Factory Default:

```
passtopassmode disable off off default 1.0
```

ASCII Examples

1. To enable DGPS and OmniSTAR VBS:

    ```
    PASSTOPASSMODE enable on off:
    ```

2. To enable SBAS

    ```
    PASSTOPASSMODE enable on on
    ```

---

[2] Refer to Section 2.4 of the *OEMV Family Firmware Reference Manual Revision 5* for more information on factory defaults.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PASSTO-PASSMODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Enable or disable pass to pass smoothing mode (recommended = ENABLE)	Enum	4	H
		ENABLE	1				
3	measmth	ON	1	Enable or disable measurement smoothing mode (recommended = ON default = OFF)	Enum	4	H+4
		OFF	0				
4	corrsmth	ON	1	Enable or disable correction smoothing mode (recommended = ON default = OFF)	Enum	4	H+8
		OFF	0				
5	deweight	OFF	0	Pass to pass deweight mode (default = DEFAULT)	Enum	4	H+12
		DEFAULT	1				
		LOW	2				
		HIGH	3				
6	scale	scale > 0		Deweight scale (default = 1.0)	Double	8	H+16

Final Points

If you require further information, regarding the topics covered by this document, please contact:

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