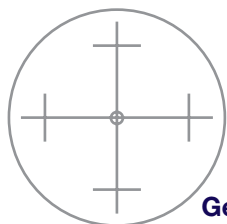


Dynamic attitude verification

Attitude Control Pitch, Roll and Heading



Key features

- Dynamic Pitch, Roll and Heading verification

General

Parker Maritime AS has developed a four antenna GPS attitude verification system, AttConPRH, in collaboration with the Hydrographic Service of the Norwegian Mapping Authority (NHS) with background in our clients requests.

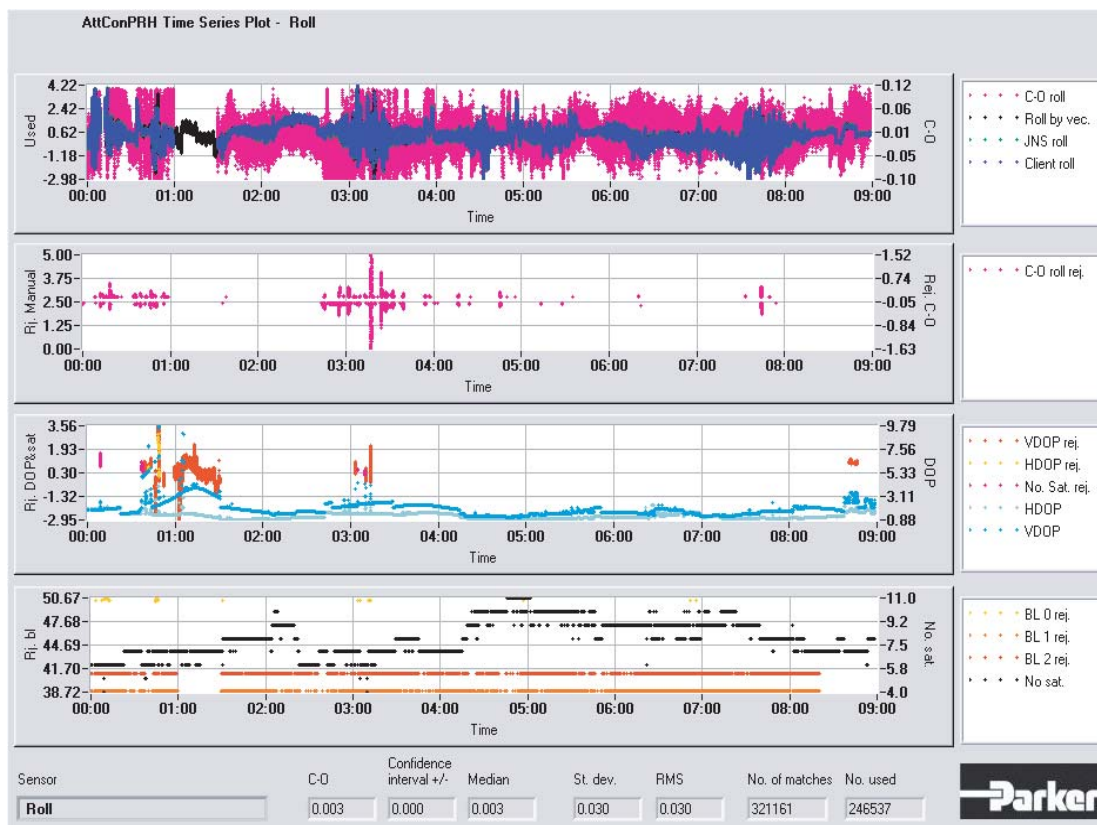
AttConPRH is designed for doing dynamic vessel attitude sensor verification.

This system enables a complete verification of the vessel sensors during realistic movements of the vessel.

Our system will output C-O values for pitch, roll and heading. Under some circumstances the Z-axis rotation offset of the vertical reference unit can be estimated.

The AttConPRH application uses statistical and geometrical filtering such as vector lengths and satellite constellation (number of satellites, HDOP and VDOP).

The below print from the software shows a typical Roll summary of a survey, such as C-O, our GPS and client sensor values.



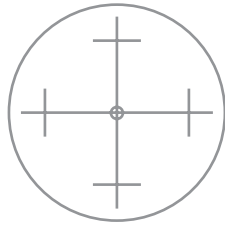
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Dynamic attitude verification

Attitude Control Pitch, Roll and Heading

The following list outlines the sequence of operation:

Key features

- Dynamic Pitch, Roll and Heading verification

Item	Description	Action
1	Establish permanent antenna mounts on the vessel.	Client and Parker
2	Establish coordinates for the antenna mounts in the vessel reference system.	Client and Parker
3	Perform first GPS attitude determination.	Client and Parker
4	Perform first calculation of C -O.	Parker
5	Enter new C -O in vessel system.	Client
6	Wait for sensor to stabilize with the new setup values.	Client and Parker
7	Perform second GPS attitude determination to verify results.	Client and Parker
8	Perform second calculation of C -O.	Parker

Item 1 and 2 must be done in advance of mobilising the verification equipment and personnel to the vessel and will normally be done only once.

The rest of the items will be performed every time the verification is done.

The C-O values are obtained using three different methods for quality control. The below print shows the result summary with estimated C-O values and the parameters used in the processing.

AttConPRH results

Name	C-O	Confidence interval	Median	SD	RMS	No. of matches	No. used
Pitch	0.003	0.003 - 0.003	0.003	0.014	0.015	321161	248263
Roll	0.003	0.003 - 0.003	0.003	0.030	0.030	321161	246537
Hdg.	0.017	0.016 - 0.017	0.014	0.112	0.113	321161	235908
Pitch by vector	0.003	0.002 - 0.003	0.003	0.029	0.029	321161	231653
Roll by vector	0.001	0.001 - 0.001	0.002	0.048	0.048	321161	231653
Hdg. by vector	0.025	0.024 - 0.026	0.017	0.146	0.148	321161	231653
LSA pitch	0.001			0.000		321161	289616
LSA roll	0.004			0.000		321161	289616
LSA hdg	0.027			0.000		321161	289616
LSA z-rot.	-0.271			0.014		321161	289616

Summary of applied settings:

Average pitch: 0.002, Average roll: 0.003, Average hdg.: 0.023, Z-rotation: -0.271

The confidence interval is computed with 95 % confidence level

Datasnooping is ON. Tests performed:
 Min. no. of satellites: 6
 Max. HDOP allowed: 3.0
 Max. VDOP allowed: 3.0
 C-O is normalized and tested with T-test value 0.95
 GPS vector lengths are normalized and tested with T-test value 0.95

Basefile: GPS file
 Javad master file: 20080125_220512_COM1.log
 Javad slave file: 20080125_220512_COM14.log
 Client file: data.pf_0864_2_10.txt
 Time correction added to the Client time: 0.0

Coordinates [m] (across [stbd+], along [fwd+], height [dwn+]):
 Master: (0.000,0.000,0.000)
 Slave 0: (4.219,46.792,18.165)
 Slave 1: (-6.415,33.728,18.109)
 Slave 2: (14.815,33.769,18.100)

Maximum deviation allowed for baseline processing [m]: 0.025



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