



Test Report

Verification of Heading Performance

Issued: 2002-04-08

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1. INTRODUCTION

This report contains description and results from tests performed on the Seapath products to verify the heading performance. Seapath 200 version 2 has a specified heading accuracy of 0.075 degrees RMS (with a 2.5 meters GPS antenna baseline).

The reference for heading, roll and pitch performance during the test have been a Honeywell INS - H726 MAPS (DRU) Hybrid. This reference system has a specified heading accuracy of 0.05 degrees.

The tests have been performed to document the performance in:

- Both straight lines and during and after turns.
- Both bad weather with big waves and in conditions flat sea

1.1 Seapath 200 Description



Figure 1. Seapath 200 main components with the MRU-5 motion sensor, the Processing Unit and the Antenna Bracket (Rack) with two GPS antennas

1.2 Description of test at Titran May 2000

We went out to Titran late May 2000 to test the Seapath 200. Titran is the closest harbour to Trondheim with open sea waves. Here there can be waves with several meters height and more than 10 seconds period. We experienced wave periods of 5-10 seconds and heave heights of 1-2 meters. In addition to the Seapath 200 we brought an INS from Honeywell.



Figure 2. A Searef 200 GPS reference station was installed in the Seatex van with an L1/L2 GPS antenna on top of the van. A UHF radio transmitted DGPS corrections to the boat.



Figure 3. The Seapath 200 was installed on a 32 feet fishing boat along with an INS attitude reference system.

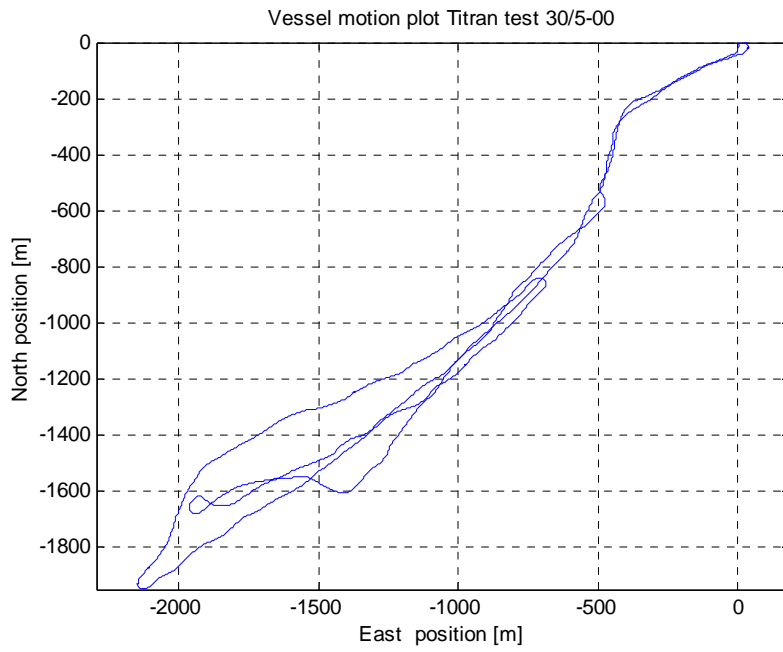


Figure 4 shows the position of the boat during the survey.

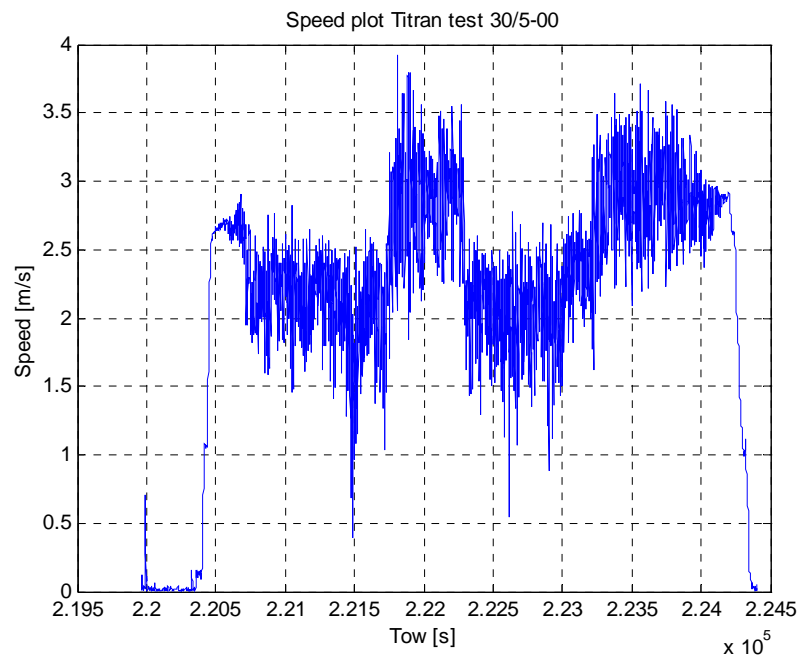


Figure 5 shows the ship speed during the survey.

1.3 Description of test at Trondheimsfjord September 2000

New sea trials outside Trondheim were performed with Sea Rover in September 2000 to test the Seapath 200. Here the wave heights are usually less than 1 meter and with 5-10 seconds period. We experienced very nice weather with an almost flat sea surface. In addition to the Seapath 200 we brought an INS from Honeywell.



Figure 6. The 40 feet former ambulance boat Sea Rover.

1.3.1 Not optimal antenna installation

The GPS antennas were mounted very close to the roof of the boat. This is not optimal with respect to Multipath, and we might experience larger heading errors than expected with this installation. The height difference between the antennas and the boat roof shall be at least twice as the width of the boat roof in an optimal GPS antenna installation with respect to Multipath.

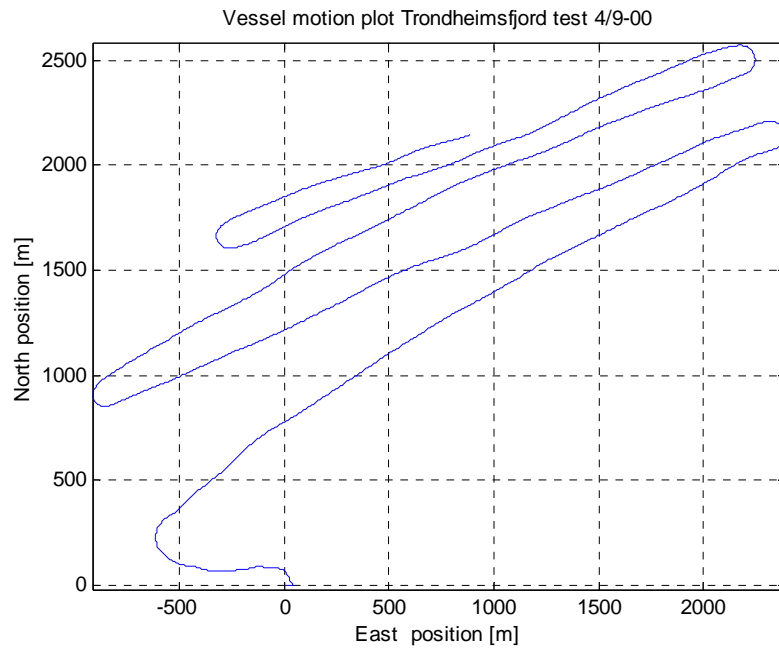


Figure 7 shows the position of the boat during the survey.

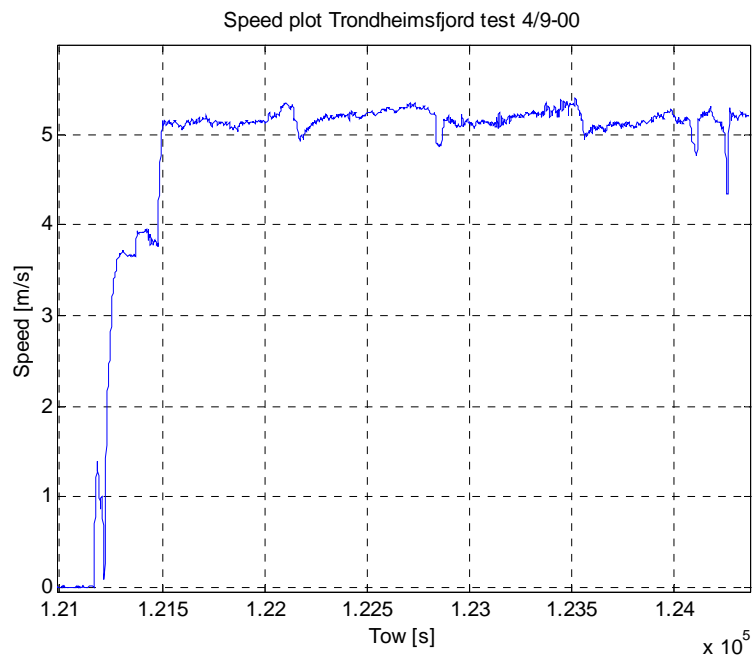


Figure 8 shows the ship speed during the survey.

2. RESULTS FROM TITRAN TEST 30/5-00

2.1 Straight line track, 400 seconds

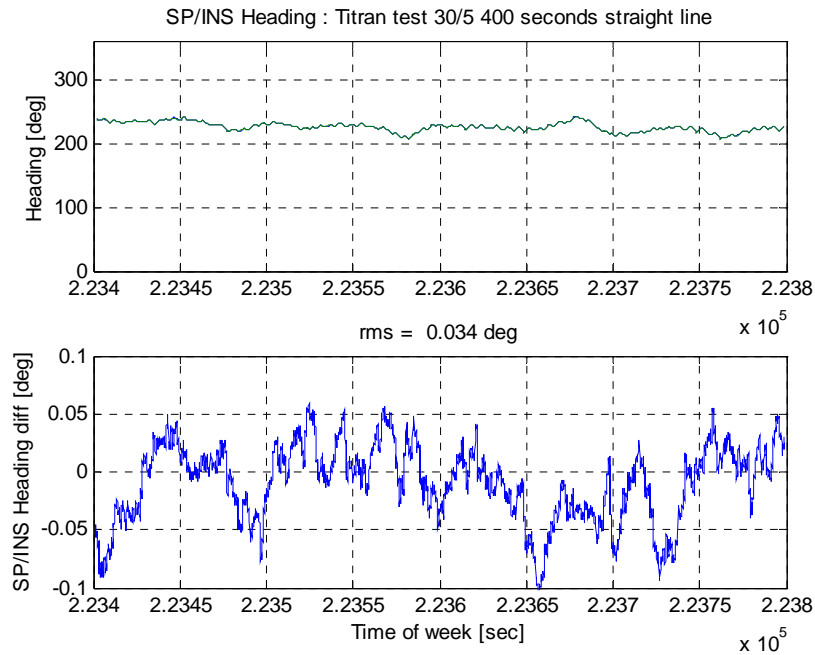


Figure 9. Upper plot: Seapath 200 heading during a 400 seconds straight line track. Lower plot: Heading difference between Seapath 200 and INS. RMS is 0.034 degrees.

2.2 180 degrees turn followed by straight line, 500 seconds

The boat makes a 180 degrees turn at tow 222300 seconds, where it is seen that the heave frequency increases as the boat goes up against the waves instead of along the waves.

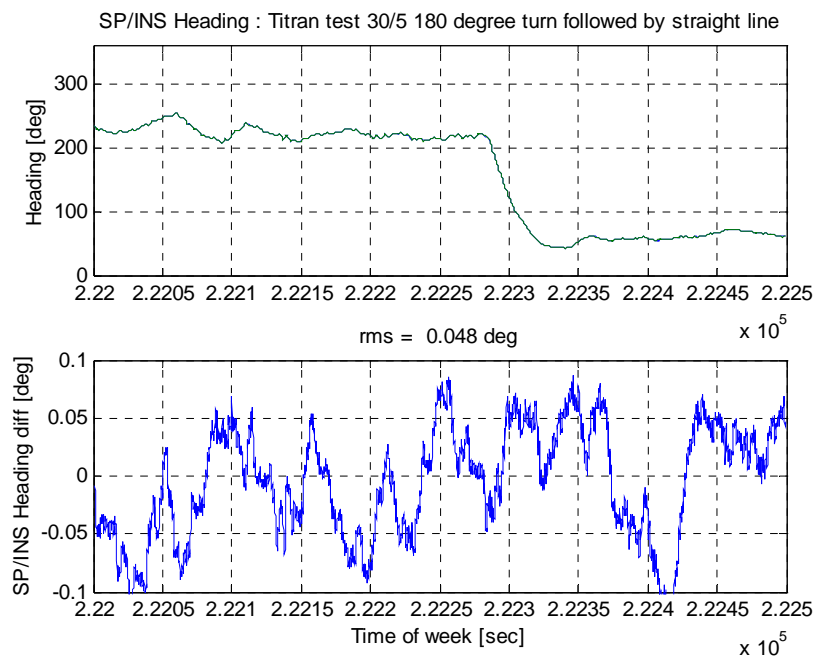


Figure 10. Upper: Seapath 200 heading during a 180 degree turn followed by a straight line track. Lower: Heading difference between Seapath 200 and INS. RMS is 0.048 degrees.

3. RESULTS FROM TRONDHEIM TEST 4/9-00

3.1 Straight line track, 400 seconds

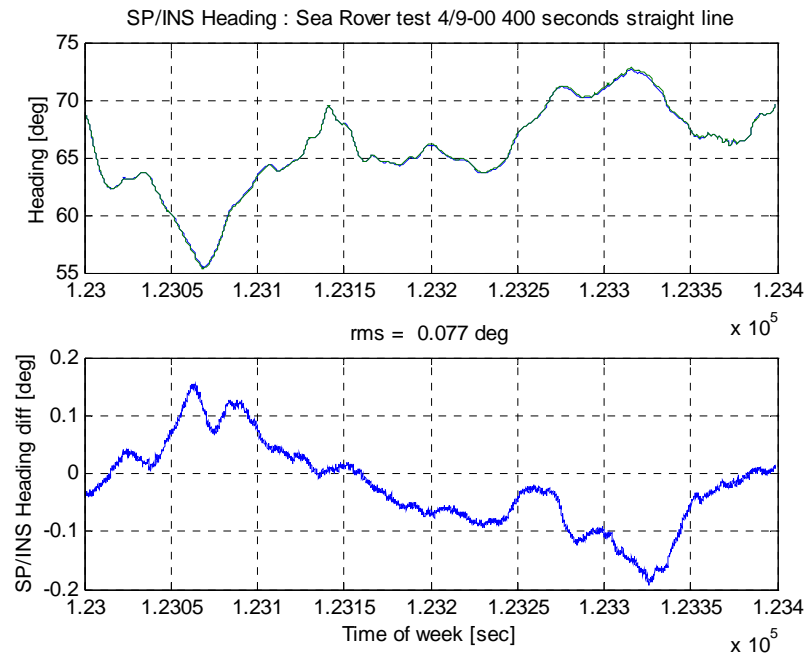


Figure 11. Upper plot: Seapath 200 heading during a 400 seconds straight line track. Lower plot: Heading difference between Seapath 200 and INS. RMS is 0.077 degrees. Some part of this difference is due to the INS, which has a specified accuracy of 0.05 degrees. By assuming uncorrelated errors from Seapath of 0.075 degrees and 0.05 degrees from the INS, then the difference will have a standard deviation of 0.090 degrees. The errors would also have been smaller with an optimal antenna installation (ref. 1.3.1).

3.2 180 degrees turn followed by straight line, 300 seconds

The boat makes a 180 degrees turn at tow 12353 seconds.

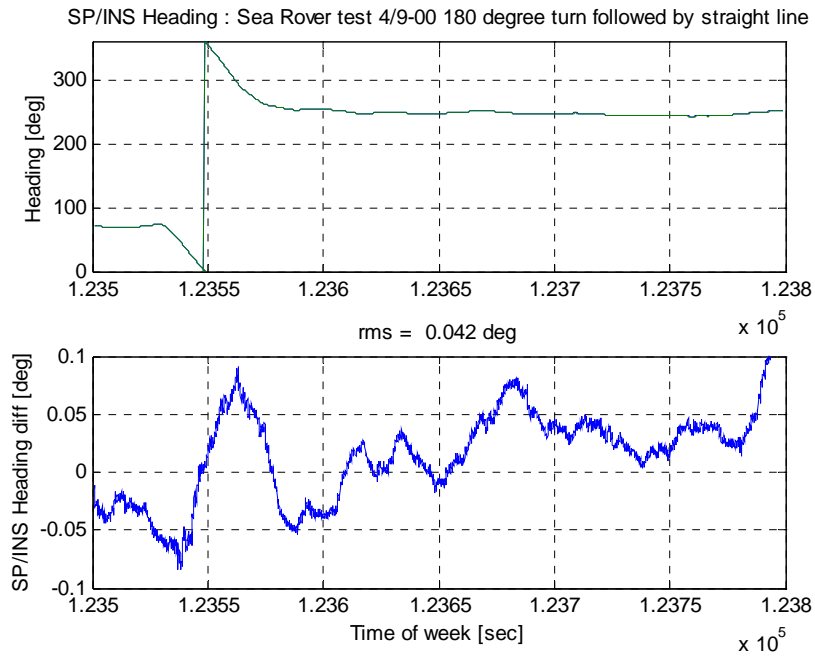


Figure 12. Upper: Seapath 200 heading during a 180 degrees turn followed by straight line. Lower: Heading difference between Seapath 200 and INS. RMS is 0.042 degrees.