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Test Report iVRU-CB-M

(excerpt)

Commercial-in-Confidence



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1 SCOPE

This report provides test results obtained from an iVRU-CB-M, compared with a high performance reference INS/GNSS system of type iTraceRT-F400. The iVRU-CB-M, equipped with 3 MEMS gyros, 3 MEMS accelerometers and integrated GPS L1 receiver (odometer not used in these tests), is operated in real-time with its integrated iMAR's proprietary 15+ state Kalman filter algorithm. The high system accuracy is demonstrated in field tests which are documented in this paper.

2 RESULTS

The iVRU-CB-M and the iTraceRT-F400 are mounted together in a car (Audi A6), both are supplied from the same GNSS antenna via an antenna splitter.

The following plots show the results of both units and the differences between them. The iTraceRT-F400 is based on an accurate fiber optical gyro and servo accelerometers and provides angular accuracy of roll/pitch of better 0.02 deg and heading better 0.03 deg. The data rate of the iTraceRT-F400 is 400 Hz, the iVRU-CB data rate was adjusted at 100 Hz (internal raw data processing at 200 Hz).

The iVRU-CB performance is described in its datasheet. The test results show, that the performance in real environment is better than given in the datasheet.

The test track shown in the following was acquired in regular traffic.

2.1 Test Results with standard GPS condition

The GPS coverage was standard, i.e. no longer outages had been observed during this test.

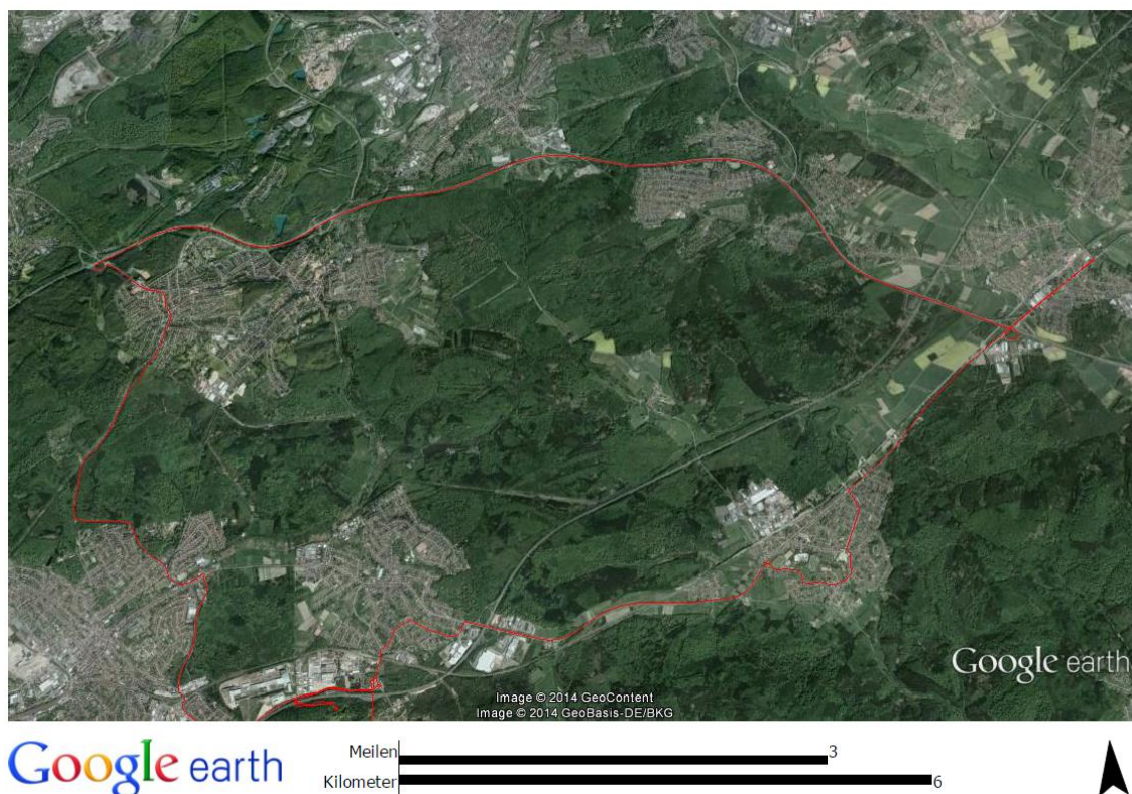


Figure 1: Trajectory in © GoogleEarth, red = iVRU-CB-M

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The figure shows the driven trajectory over a duration of about 1 hour. It can be well seen that the trajectory follows a street, which is located partially in rural area, partially in town and partially in dense forest.

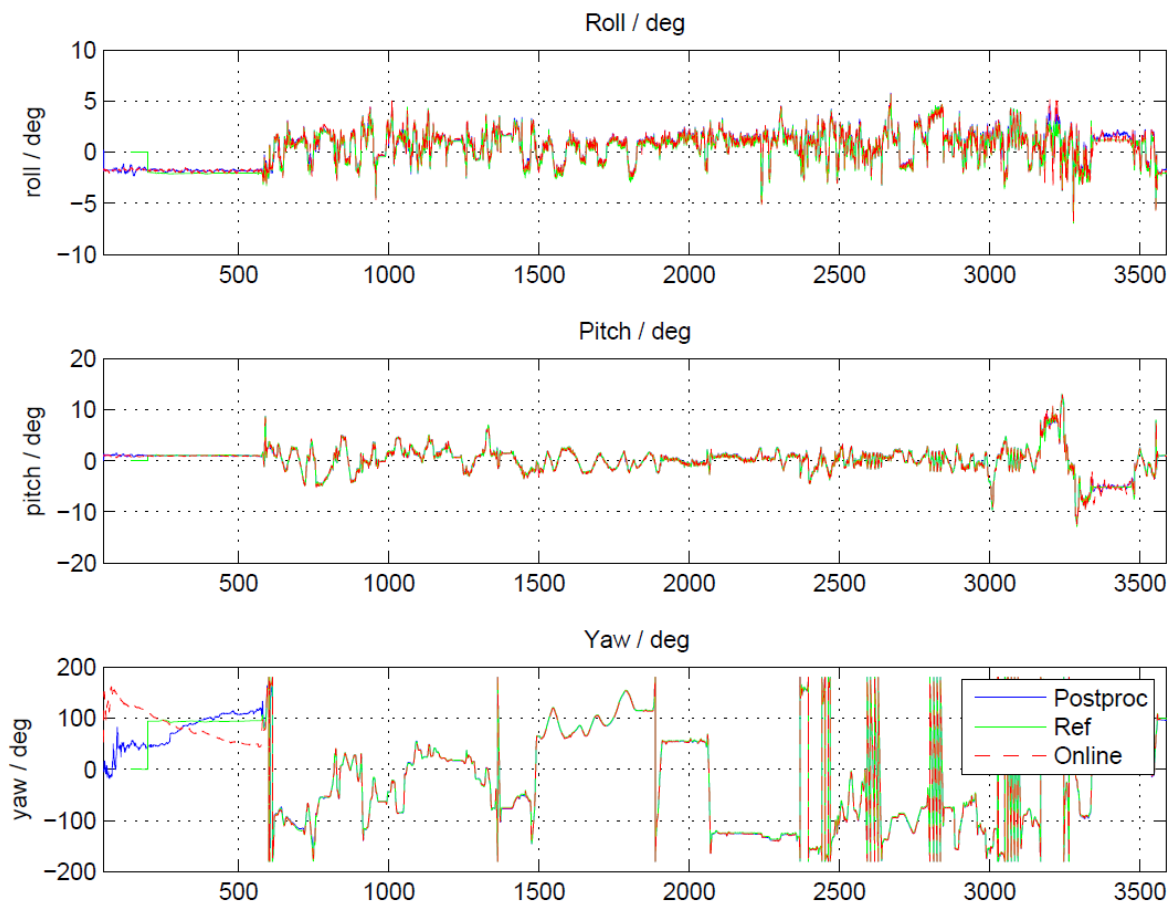


Figure 2: Roll and Pitch and Yaw Results of iVRU-CB-M (online / red and post-proc / blue), compared with the reference platform iTraceRT-F400 (green), plotted angle [deg] over time [sec]



Figure 3: iMAR's Reference INS/GNSS system iTraceRT-F400



Figure 4: iMAR's Reference INS/GNSS system iNAV-RQH (0.002°/h)

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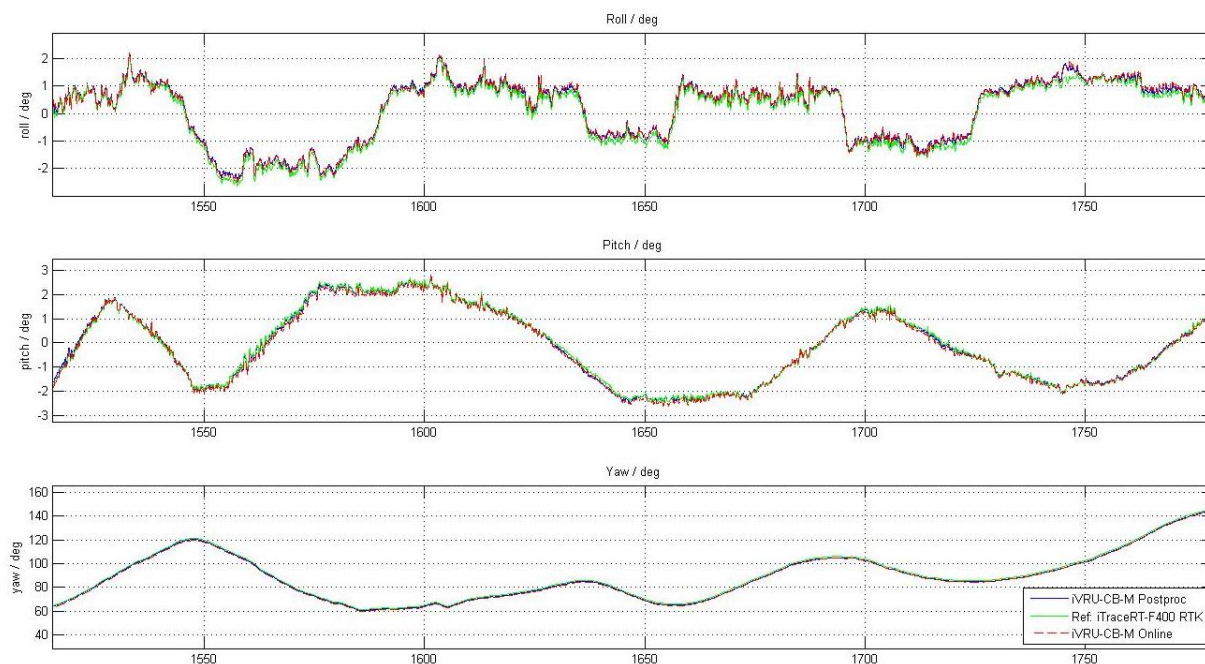


Figure 5: Zoom of Roll, Pitch, Heading iVRU-CB-M against iTraceRT, plotted angle [deg] over time [sec]

The RPY figure demonstrates the high angular performance of the iVRU-CB-M. The dynamic roll/pitch accuracy is better than 0.2 deg rms and the heading is better than 2 deg rms. The heading drift at stand-still (no heading aiding by GPS due to zero velocity) is < 0.1 deg over 30 sec, i.e. < 0.003 deg/s resp. < 10 deg/h.

The next figure shows the deviation between iVRU-CB-M and reference unit iTraceRT-F400. It shows that the standard deviation of roll/pitch is with 0.2 deg well below the specified 1 deg even under dynamic conditions.



Figure 6: iMAR's iVRU



Figure 7: iMAR's iVRU-FC

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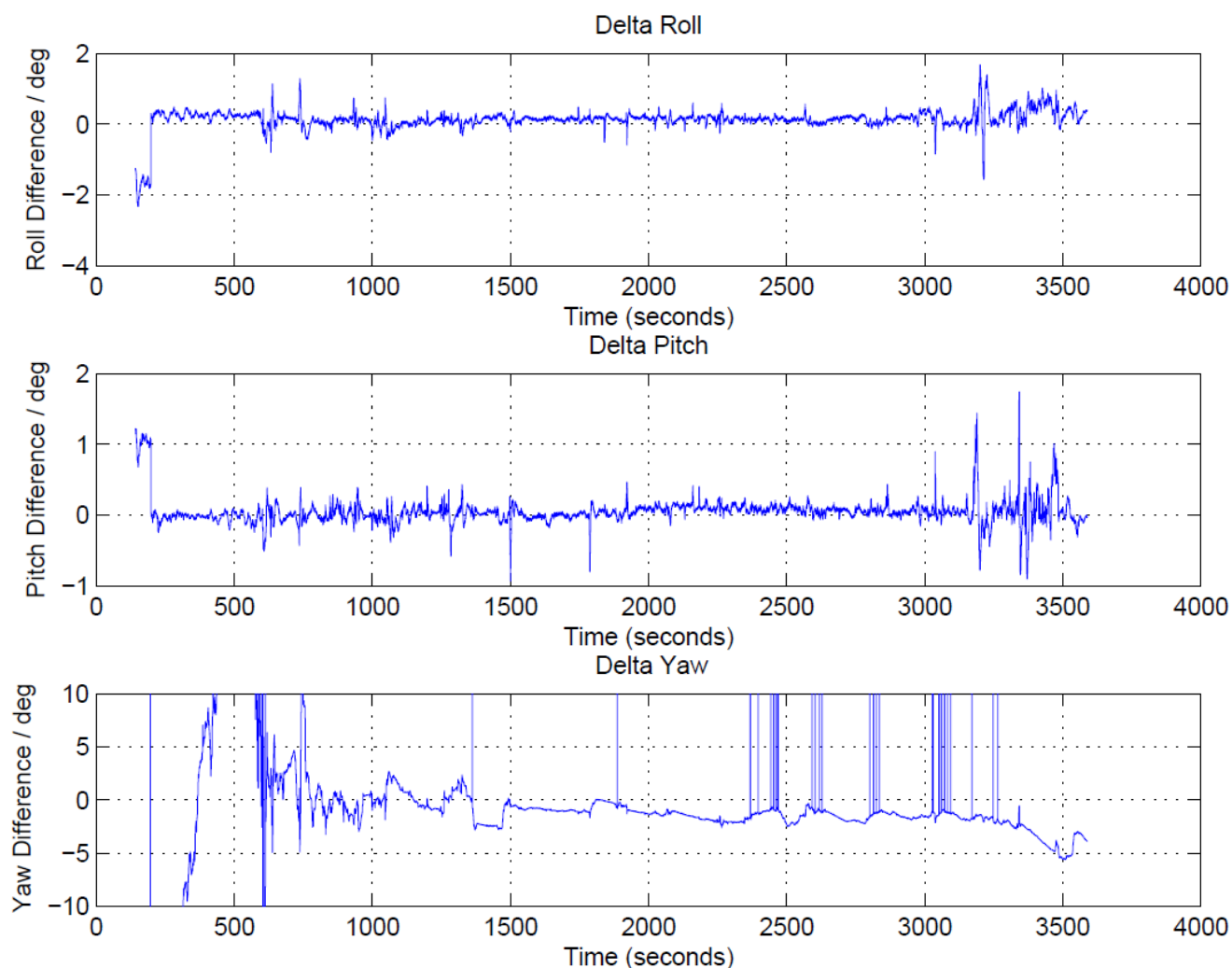


Figure 8: Deviation between iVRU-CB-M and iTraceRT-F400 in Roll, Pitch and Yaw

The “pseudo peaks” seen in the yaw difference are only the reason of scaling (comparing data, which are limited between ± 180 deg and where the one measurement system e.g. provides 179.5 deg and the other -179.5 deg, so the math. difference is 359 deg, i.e. 1 deg).

The next figure shows the horizontal velocity provided by the iVRU-CB-M with 100 Hz data rate. The dots show the position update of the integrated GPS receiver, the red line shows the IMS/GNSS navigation solution.

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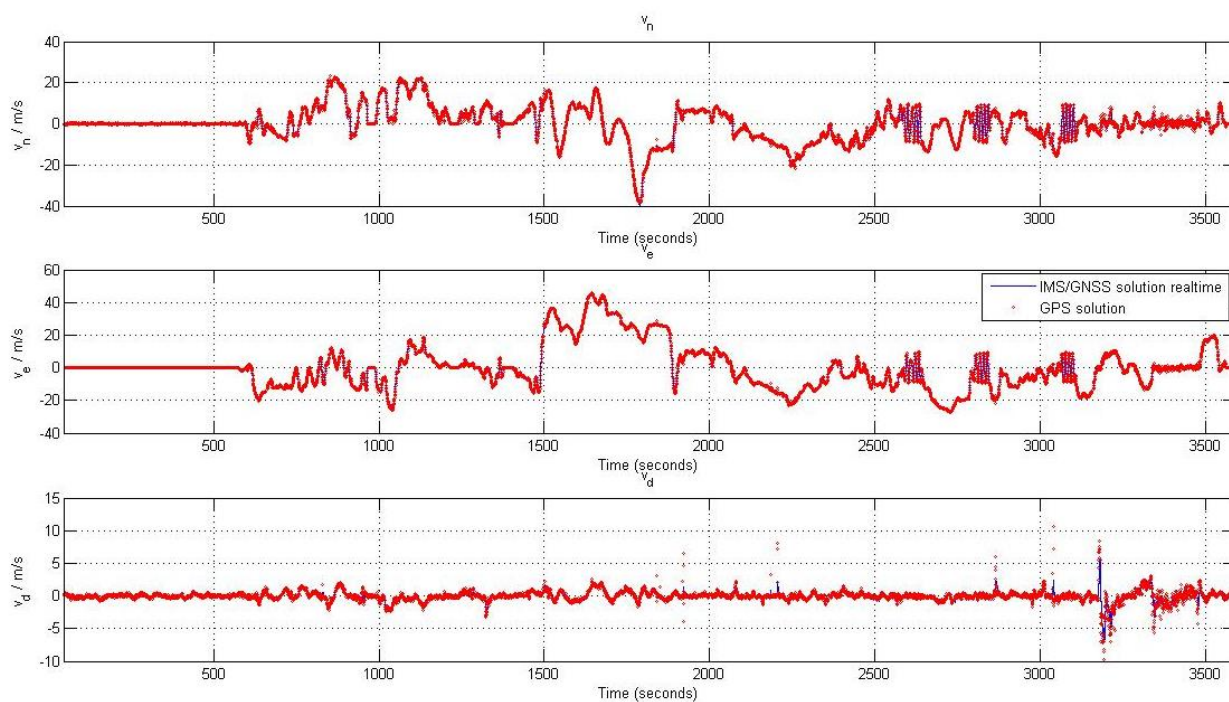


Figure 9: Velocity output of the INS/GNSS solution vs. GPS velocity

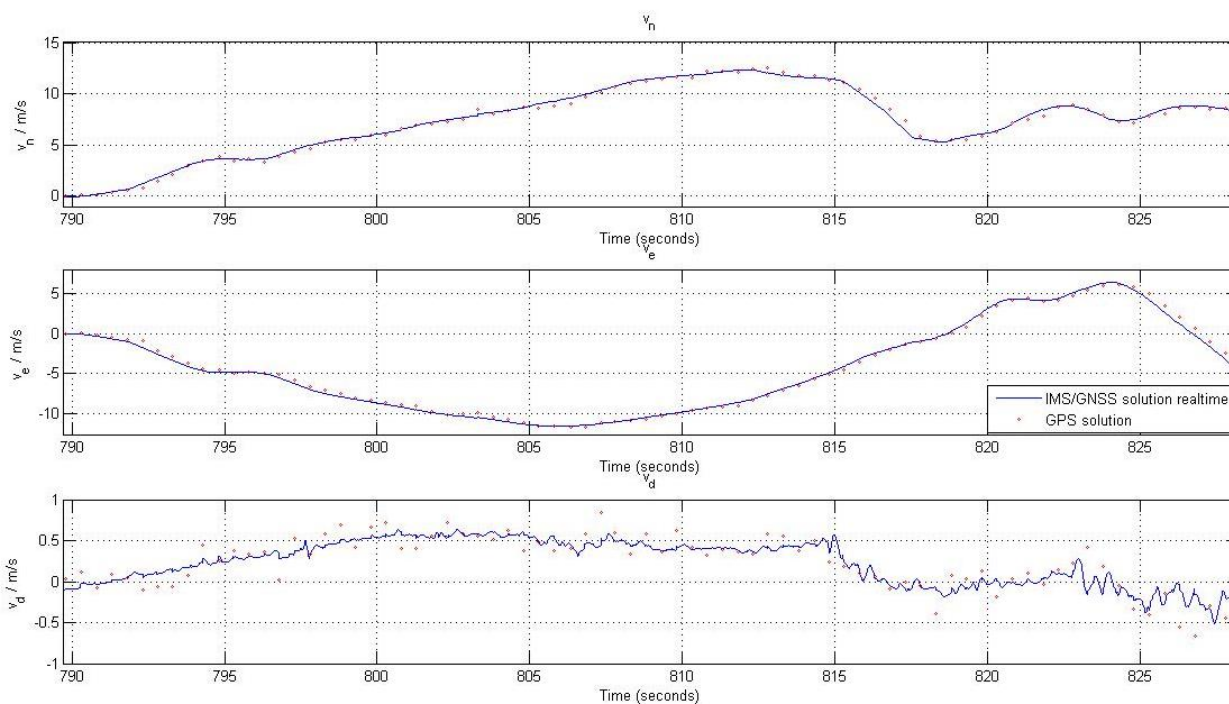


Figure 10: Zoomed velocity output of the INS/GNSS solution vs. GPS velocity

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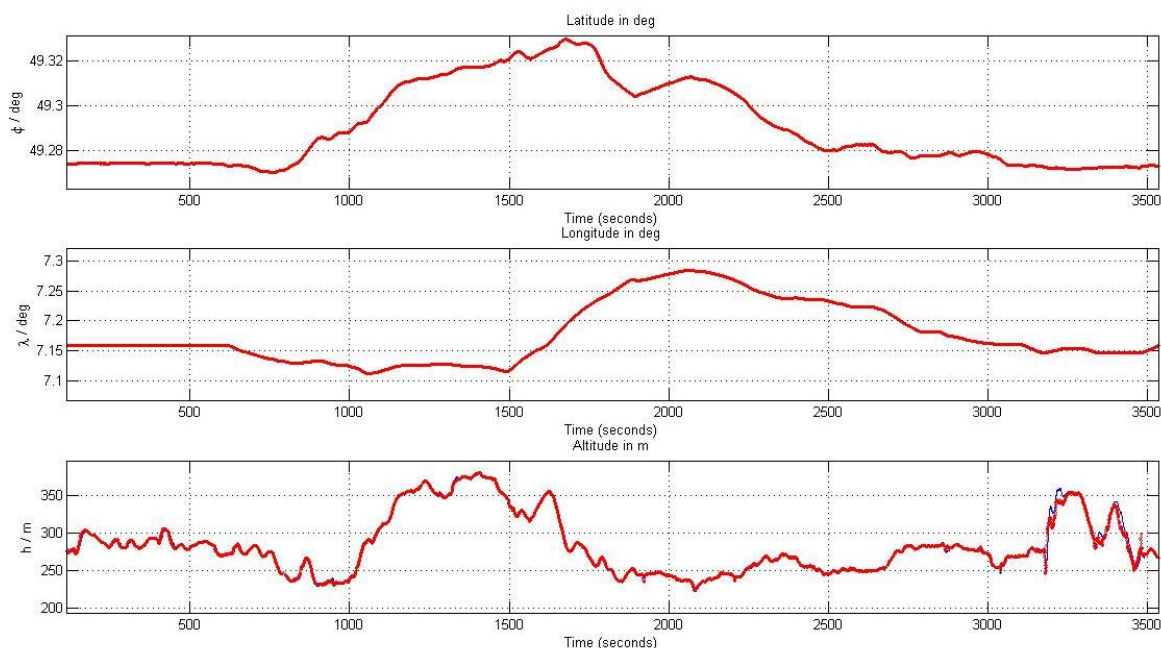


Figure 11: Position output of the INS/GNSS solution vs. GPS position

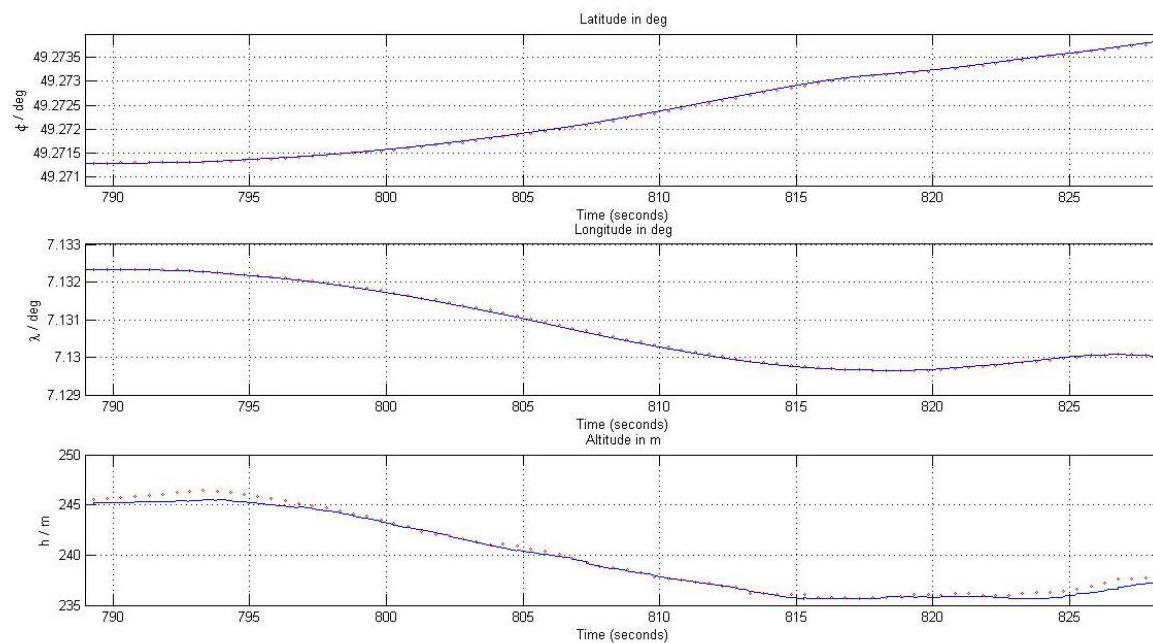


Figure 12: Zoomed position output of the INS/GNSS solution vs. GPS position

The results in position and velocity show a good accuracy, which is mainly determined by the L1 GPS horizontal accuracy of about 3 m (no DGPS adding was used). In the horizontal as well as in the vertical direction the inertial measurement system smoothes the GPS outliers and provides the output data with the full IMS bandwidth and data rate of 100 Hz.