An Experimental Project of Inertial Navigation and Relative Positioning Performance

A cooperation between LINK-SIC and UMS Skeldar

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Abstract

In this project, experimental tests were designed, planned and executed to evaluate navigational sensor performance of the UAS Skeldar V-200. Sensor data were collected and analysed by performing practical tests with a mobile UAV test rig. Inertial navigation and relative positioning performance were investigated by conducting different tests. Finally, data from the tests were plotted with various tools, and the overall navigation performance was evaluated.

Method

The experimental tests for the sensors were designed to resemble actual situations which the UAV Skeldar V-200 could encounter. Inertial navigation was determined to be tested by creating a GNSS outage, and relative positioning by resembling an approach to land on a ship's helipad.

During the GNSS outage, sensor data were gathered from a test rig mounted on a car trailer. Different routes were covered with the test rig to evaluate the performance of the inertial navigation under various conditions. The relative positioning was tested by making the test rig act as a ship, and another smaller setup as the UAV. Relative positions were measured and logged by moving the smaller setup towards the larger test rig.

Gathered data from the experiments were plotted in order to estimate the navigational performance of the sensors. Geographical visualisation was made possible by using Matlab and Google Earth. The distance and time of dead reckoning under inertial navigation, as well as the relative positioning error and accuracy wer e calculated and analysed to estimate the sensor performance.

Figure 1. Experimental setup. The navigation sensors are Attached to the wooden UAV test chassis.

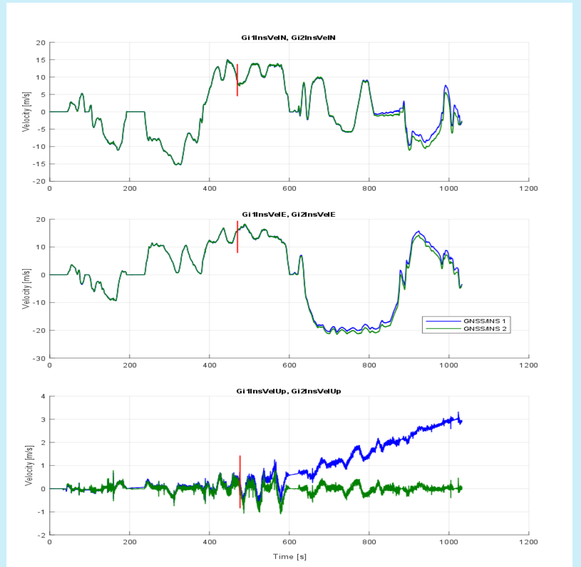

Figure 2. Plot of the velocity components (North, East, Up) from a inertial navigation test. GNSS/INS1 represents the sensor that experienced a GNSS outage, and GNSS/INS2 the reference which did not experience a GNSS outage.The red lines mark at what time the outage occured.

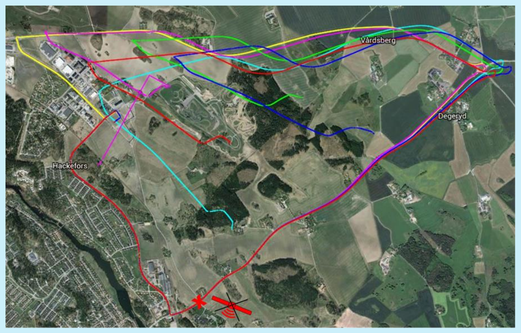

Figure 3. The yellow line represents the actual route from GNSS/INS 2, and the other colours represent the tests. The red satellite indicates where the GNSS outage was initiated. The figure is cropped from Google Earth.

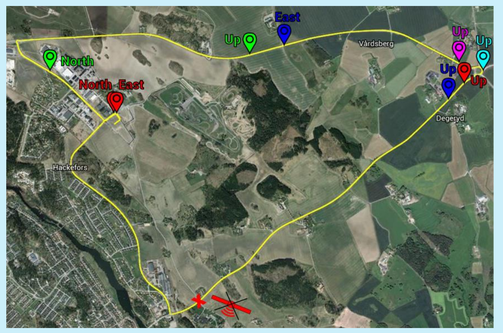

Figure 4: Pins showing where the velocity limits were breached for the inertial navigation tests. The red satellite indicates where the GNSS outage was initiated, and the different colours on the pins represent the tests. The figure is cropped from Google Earth.

Results

The results from both the inertial navigation and relative positioning testing showed highly satisfying performance of the provided navigation sensors.

For the inertial navigation, the navigation sensors could cover a satisfactory distance before the velocity deviation limits set by the company were exceeded. This was especially noticable when the test rig travelled in a straight path, and did not make many turns.

Results from the relative positioning tests showed that the navigation sensors could measure the relative position between the two test rigs with high precision. The precision in all directions (x,y,z) of the relative positioning was considered well within desired performance requirements set by the company.

Thank you

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References

For inquiries regarding references and additional information, please contact UMS Skeldar at: info@umsskeldar.aero

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