Title: **Integrating INS and GNSS Sensors to Provide Reliable Surface Positioning**

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Abstract

The ideal surface positioning system will provide a constant, stable, accurate and repeatable position in real-time which is essential to safe and productive operations. In perfect conditions, GNSS along with augmentation data can deliver this performance and with the modernization of existing constellations and the imminent arrival of new satellite constellations the performance and availability of GNSS should improve. However, while additional observations will be available, the satellite signals are still susceptible to effects of ionosphere scintillation and interference whether intentional or un-intentional plus signal blockage can occur when working close to platforms and this will result in degraded positioning.

Inertial Navigation involves determining a position through dead reckoning using gyros and accelerometers to calculate changes in position, velocity and attitude. Inertial Navigation Systems (INS) are completely self contained and inherently robust providing output with exceptional good short term accuracy but the position accuracy will drift with time.

INS and GNSS are complementary sensors and when combined can deliver constant, stable, accurate and repeatable positioning. The integration of GNSS and inertial technologies exploits the long term accuracy and precision characteristics of GNSS positioning with the continuous availability and fast update rate of inertial sensors. The resulting integrated system can bridge GNSS disruptions (e.g. ionospheric scintillation, physical obstructions, etc.) as well as detecting position outliers due to common mode failures which can affect vessel GNSS systems simultaneously which is particularly advantageous for DP operations.

This paper will present a high level overview on the integration of GNSS and INS sensors required to deliver an integrated position solution considering the different options and also examining the benefits and weaknesses of the different solution options.

Results from real-world trials will be presented showing the performance of a loosely-coupled INS and high-accuracy GNSS position solution. In particular, several scenarios were tested to simulate the degradation of the GNSS data to look at the performance of the integrated solution which highlights the advantages of combining the two different sensors. The testing scenarios also considered a complete failure of the GNSS solution to monitor how quickly the position accuracy degraded when only the INS sensor was available.

Finally, the real-world operational implementation of an integrated system will also be considered as this will be different depending on whether the system is being used for DP operations or survey operations.

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