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Low-Cost MEMS-Based NARX Model for GPS-Denied Areas

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Abstract*—Autonomous vehicle navigation has witnessed a huge revolutionary revision regarding development in Micro-Electro Mechanical System (MEMS) technology. Most recently, Strapdown Inertial Navigation System (SDINS) has successfully been integrated with Global Positioning System (GPS). However, different grades of MEMS inertial sensors are available and choosing the convenient grade is quite important. Noises in inertial sensor are mostly treated through de-noising the additive errors to improve the precision of SDINS output. Unfortunately, integration in SDINS mechanization causes a growing in SDINS error output which considered the main challenge in integrating MEMS inertial sensors with GPS. This paper aims to promote the long-term performance of the MEMS-SDINS/GPS integrated system. A new integrated structure is proposed to model the nonlinearities that exist in SDINS dynamics in addition to the error uncertainty in the inertial sensors' measurements. A robust Nonlinear AutoRegressive models with eXogenous inputs (NARX) based algorithm are designed for data fusion in the proposed GPS/INS integrated system. Validation for the proposed integrated system has been carried out using different field tests data in order to assess the accuracy of the system during GPS denied environment. The results obtained demonstrate that the proposed NARX model is applicative and satisfactory which shows a desired prediction performance.*

***Index Terms*—** *INS, GPS, NARX, MEMS, IMU*

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