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Towards Improved Assistive Inertial Positioning Solutions by Using Finely Tuned Wavelet Functions

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Abstract

In this article, we discuss improving navigation accuracy by refining signals achieved from the inertial navigation system's (INS) detection unit. The accuracy of navigation depends on inertial sensors to a large extent. However, their errors can cause interference with signals. Researchers have developed different calibration procedures to address this issue to integrate INS navigators with other navigators. Two types of errors exist - deterministic and stochastic. Sensor noise greatly affects navigation solution quality. Traditional noise reduction methods cannot directly filter noise in the navigation signal due to its frequency spectrum. An alternative option is to use wavelets to denoise signals from inertial sensors. Our methodology uses fine-tuned wavelet functions and the Directed Transfer Function approach to eliminate noise interference with the sensors' signals. Reference signals obtained from Global Positioning Satellites (GPS) are utilized during the tuning process. We tested our technique by installing an INS navigator with a micro-electro-mechanical (M.E.M.S.) inertial measurement unit and a GPS navigator in a portable assistive device. We optimized the wavelet filters' decomposition levels for each inertial sensor in the measurement unit by analyzing experimentally acquired data. This method can significantly impact various industries, including human assistive technologies, transport, and logistics. It can also be extended for indoor monitoring purposes.

Keywords: inertial navigation systems, tuned wavelet functions, assistive positioning

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