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Navigation system based on MEMS sensor for indoor and outdoor environment

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In presented work, the authors focused on the issue of evaluating inertial pedestrian navigation system based on MTI/MEMS sensor in indoor and outdoor environment. In this case, the XSENS MTI IMU device was tested successfully by strapping it on foot/shoe of a moving person. It can be also easily attached to any walking machines/robots for step detection. The presented indoor positioning algorithm has been implemented in a Kalman-based framework. The extended Kalman filter (EKF) is updated with velocity and angular rate measurements by the zero-velocity-update (ZUPT) and zero-angular-rate update (ZARU) combination. The step detection combined with ZUPT and ZARU solutions is an advantage for calculating the actual position, distance travelled and estimating the IMU sensors' inherent accumulated error by EKF. The experiment with IMU device has been performed and analyzed to evaluate the performance of the proposed method. The combined PDR final results were compared to GPS/Beidou post-processing kinematic results (outdoor environment) and to real route which was prepared and calculated for indoor environment. After the comparison, the results show that the accuracy of the normal walking (100 Hz) under ZUPT and ZARU compensation form in the case of outdoor positioning did not exceed 0.19 m (STDEV) and for indoor positioning accuracy did not exceed 0.22 m (STDEV). The authors are aware that the inherent drift errors of accelerometers and gyroscopes, the velocity and position obtained by IMU are only reliable for just a short period of time. Based on this discussion, future work will focus on integration presented methods with WiFi/Zigbee or image-based solutions to overcome the IMU drawback.

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