Collaborative Navigation with Ground Vehicles and Personal Navigators

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ABSTRACT

An integrated positioning solution termed ‘collaborative positioning’ employs multiple location sensors with different accuracy on different platforms for sharing of their absolute and relative localizations. Typical application scenarios are dismounted soldiers, swarms of UAV’s, team of

robots, emergency crews and first responders. The stakeholders of the solution (i.e., mobile sensors, users, fixed stations and external databases) are involved in an iterative algorithm to estimate or improve the accuracy of each node's position based on statistical models. This paper studies the challenges to realize a public and low-cost solution, based on mass users of multiple-sensor platforms. For the investigation field experiments revolved around the concept of collaborative navigation, and partially indoor navigation. For this purpose different sensor platforms have been fitted with similar type of sensors, such as geodetic and low-cost high-sensitivity GNSS receivers, tactical grade IMU's, MEMS-based IMU's, miscellaneous sensors, including magnetometers, barometric pressure and step sensors, as well as image sensors, such as digital cameras and Flash LiDAR, and ultra-wide band (UWB) receivers. The employed platforms in the tests include a train on a building roof, mobile mapping vans, a personal navigator and a foot tracker unit. In terms of the tests, the data from the different platforms are recorded simultaneously. Several field experiments conducted in a week at the University of Nottingham are described and investigated in the paper. The personal navigator and a foot tracker unit moved on the building roof, then trough the building down to where it logged data simultaneously with the vans, all of them moving together and relative to each other. The platforms then logged data simultaneously covering various accelerations, dynamics, etc. over longer trajectories. Promising preliminary results of the field experiments showed that a positioning accuracy on the few meter level can be achieved for the navigation of the different platforms.

KEYWORDS: Collaborative navigation, ubiquitous positioning, seamless indoor/outdoor positioning, GNSS, INS, MEMS-based sensors, UWB.