Collaborative Positioning – Concepts and Approaches for more Robust Positioning

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SUMMARY

Collaborative or cooperative positioning techniques (CP) have been adopted from the field of wireless sensor networks as an approach to improving the navigation and positioning performance for a range of human and land vehicle navigation applications. This is particularly relevant for those applications operating in GNSS challenged environments where requirements for positioning availability cannot be met and/or which are safety critical, requiring higher levels of reliability and integrity. CP techniques typically leverage an available communications infrastructure to share information between users operating within a defined neighbourhood or so-called ad hoc network. This shared information can be integrated to deliver more robust positioning performance. Under certain conditions, the communications infrastructure itself can be used as a measurement source for positioning. For example, Dedicated Short Range Communications (DSRC) infrastructure which is being deployed in many countries to facilitate a range of Intelligent Transportation systems (ITS), has the potential to provide a ranging measurement between vehicles in a vehicular ad hoc network (VANET). What is emerging as a significant consideration for CP are the benefits for positioning in terms of availability, integrity, reliability and accuracy versus cost in terms of infrastructure, computational overheads and the overall quantity and quality of information that needs to be shared to meet the positioning requirements of a specific application. In this paper, the broad applicability of CP algorithms and techniques for land mobile applications is discussed. A range of qualitative and quantitative measurement information that can support CP is presented such as low cost MEMS based inertial sensors, map matching and DSRC. An initial cost benefit assessment of these 'measurements' is undertaken, in addition to considerations for determining the point of diminishing marginal utility for positioning i.e. at what point does the integration of additional information provide a negligible return to the positioning performance. This is an important step forward in redefining the concept of ubiquitous positioning from the traditional idea of integrating all available signals of opportunity, towards identifying the optimal set of measurements for the requirements of the application i.e. fitness for use. In this paper measurements collected during field experiments conducted under a joint FIG working group (5.5) and IAG sub commission (4.2.1) entitled Ubiquitous Positioning are analysed and evaluated in the context of CP. Full details of the experiments, practical results and future directions are presented.