論文の内容の要旨

Accurate and Efficient Node Localization in Wireless Sensor Networks

（無線センサネットワークにおける正確で効率的な位置同定）

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Localization algorithms for wireless sensor networks (WSNs) have been designed to find per-node location information, which is a key requirement in many applications of WSNs. Generally speaking, based on the type of information required for positioning, protocols can be divided into two categories: (i) range-based and (ii) range-free protocols. In this thesis, we focus on the investigation of localization algorithms for traditional WSNs, mobility-assisted WSNs, mobile sensor network, and wireless underground sensor networks.

In this thesis, we study the node localization problem in wireless sensor networks. Based on the statistical signal processing technology, several novel algorithms are proposed. For range-free localization, we proposed a radical line based algorithm using the radio range of sensor nodes. With a slight increase in computations, this method provides a more accurate range-free localization based on the radical line of intersecting circles. Furthermore, a cooperative localization algorithm is proposed that considers the existence of obstacles in mobility-assisted wireless sensor networks (WSNs). An optimal movement scheduling method with mobile elements (MEs) is proposed to address limitations of static WSNs in node localization. For achieving high localization accuracy and coverage, a novel convex position estimation algorithm is proposed, which can effectively solve the problem when infeasible points occur because of the effects of radio irregularity and obstacles. For mobile sensor network and wireless underground sensor network, we propose the related algorithms which achieve high accuracy. It is more difficult to obtain the time-difference-of-arrival (TDOA) measurements in WUSNs than in terrestrial wireless sensor networks because of the unfavorable channel characteristics in the underground environment. In our thesis, the robust Chinese remainder theorem (RCRT) is used to robustly estimate TDOA or range difference in WUSNs and therefore improves the ranging accuracy in such networks. After obtaining the range difference, distributed source localization algorithms based on a diffusion strategy are proposed to decrease the communication cost while satisfying the localization accuracy requirement.