Wireless Sensor Networking for Intelligent Transportation Systems

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ABSTRACT

This dissertation studies the Wireless Sensor Networking for Intelligent Transportation Systems, tailored and optimized for road networks. For military scenarios, since the road networks are used for main maneuver of military troops in cities or urban areas, they need to be protected for military operations. For civil engineering scenarios, the Intelligent Transportation Systems have been developed and been evolving to support the driving safety and transportation efficiency through the information computing and communications among transportation infrastructures and vehicles. Roadways are mainly used for the transportation of people and goods and also are nowadays equipped with intelligent devices, such as electronic tollgates and variable message signs for driving. In addition to this, vehicles are equipped with GPS-based navigation systems and emergency notification systems for the driving efficiency and safety. With this trend, Wireless Sensor Networks have been considered new parts for the Intelligent Transportation Systems and are being deployed into road networks in order to enhance further the driving safety and security. This dissertation studies the key technologies in the wireless sensor networking for the security and communications in the road networks as follows: (i) Localization for sensor location, (ii) Road Surveillance for vehicle monitoring, (iii) Data Forwarding for road sensing data delivery and (iv) Reverse Data Forwarding for road condition information sharing. In order to design the technologies to be tailored for road networks, this dissertation investigates the characteristics of road networks and takes advantage of the characteristics for the wireless networking. The first characteristic is the predictable vehicle mobility within the roadways. The second is the abstract representation of the layouts of the road networks into road maps. The third is the vehicular traffic statistics representing the vehicle density on the roadways and intersections. The fourth is the vehicle trajectory representing the future vehicle mobility along the roadways, guided by the GPS navigation systems. These four characteristics open a door of new research on wireless sensor networks. Therefore, using these road network characteristics, this dissertation designs and evaluates the wireless sensor networking technologies for road networks.