SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (2)

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ANALYZING SENSOR BASED POSITIONING ON THE SURFACE OF A DISTANT PLANET

Abstract

New generation of wireless sensor networks will play significant role in planet exploration by measuring the prevailing conditions on their surfaces and atmosphere. Utilizing the capabilities of sensors we can obtain thorough pictures about the solar system bodies around us. We can not only gain new information about the planets, but we can monitor huge number of parameters in real-time to predict future environmental changes. Accurate position is relevant information for most of the performed measurements, hence we proposed and examined a positioning method for sensors in special environment such as a planet or an asteroid surface. In the proposed sensor network two types of sensors are considered. The network contains few higher performance sensors, whose dedicated purpose is to collect data from the other simple sensors and forward information to satellites, which operates as a gateway and delivers data stream to the Earth. We assumed that only high performance sensors are equipped with GPS receiver and possess sufficient energy resources, while the simple sensors use only low power radio communication to communicate with other sensors. We proposed a sensor network structure in a specific way, in order to allow the sensors to determinate their position based on estimated neighbor sensor locations. In this work we focus on the signal strength based localization method using triangulation technique for the positioning, which allows to estimate the location of a sensor using three other reference sensors. In the first step the high performance sensors are used as reference points, while in the following steps calculated sensor positions can also serve as references. The high performance sensors know their own locations, therefore the smaller sensor's position can be calculated within a small margin of error. The positioning estimation error accumulates with the proposed multi-level localization method that can limit the range, where the sensor positions can be calculated. In order to analyze the performance of the presented multi-level positioning scheme, we developed a C++ simulator tool. In the simulations we were able to examine the positioning accuracy by adjusting the sensor network parameters. We examined positioning error accumulation that depends on number of factors, such as number of sensors, sensor distance. We extended our simulator to handle terrain roughness, such as craters, dunes, and dust storms that can lead to temporal connection losses. The obtained results will help us to plan efficient sensor networks that can provide valuable information from foreign planets, asteroids.