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Static and dynamic performance evaluation of a commercially-available ultra wideband tracking system

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ABSTRACT

Locating and tracking resources (e.g., people, equipment, and materials) is critical in many industrial applications for monitoring productivity and safety. In construction, various technologies (e.g., global positioning systems (GPS), radio frequency identification (RFID) and radio frequency (RF) localization) have been proposed. However, the performance of these types of technologies is not well understood for this particular application. This paper presents a study for evaluating the static and dynamic performance of a commercially-available ultra wideband (UWB) tracking system in free space and under realistic construction environments. In addition, a static performance model for estimating position error as a function of receiver position and initial calibration error was also developed. Results and experiences are in particular useful for researchers or practitioners in need for adapting UWB technology for their application.

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1. Introduction

The need to know the location of people, equipment, materials, and other resources in near real-time is common to many industries. For example, in construction considerable time and effort is spent on trying to find needed materials within a lay down yard. In the urban search and rescue community, knowing the location of first responders within a burning or collapsed structure is even more critical. These applications have different requirements in terms of how accurately and how fast they need to track the resources.

Many technologies have been proposed for this type of resource tracking. For example, radio-frequency identification (RFID) is commonly used for inventory tracking and has also been applied to the construction tracking problem outlined above [1]. However, RFID is not inherently a localization technology, and requires considerable effort to use as such. For example, it can be combined with GPS to get position information on the RFID tags, or tags with known locations can be dispersed throughout the region of interest to obtain the appropriate level of precision on the position of a moving RFID reader [2].

Another technology that has been proposed for real-time resource locating is Ultra Wideband (UWB). UWB uses short (nanosecond) bursts of electromagnetic energy in the form of short pulse radio frequency (RF) waveforms over a large bandwidth (>500 MHz). UWB provides an ability to precisely measure the time-of-flight of a signal between a transmitter and a receiver. This capability provides a means for creating a localization system using multiple receivers by measuring the time-difference-of-arrival (TDOA) between them from multiple moving transmitters (tags). A commercially-available UWB system is shown in Fig. 1. Technical details and other advantages of UWB, e.g. that the short, wideband pulses are relatively immune to multipath effects in cluttered environments, can be found in [3].

This paper presents a study for evaluating a rudimentary simulation model for predicting the static measurement performance for commercially[3] available UWB systems. The work described herein also addresses the calibration uncertainty issue inherent in these

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[3] Certain trade names and company products are mentioned in the text or identified in an illustration in order to adequately specify the experimental procedure and equipment used. In no case does such an identification imply recommendation or endorsement by the National Institute of Standards and Technology or Georgia Institute of Technology, nor does it imply that the products are necessarily the best available for the purpose.

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