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Automatic 3D Calibration for a Multi-Sensor System

The concept of the 3D calibration method of a radio-based Multi-Sensor System for Indoor Localisation

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ABSTRACT

In this work we present a method to detect the exact position of a free moving person in a building. Therefore a simple and automatic calibration of the system, especially the sensors, is necessary. The aim of this work is to improve the positioning and body motion sensing for the tracking and recording of the status of a person.
The problem are the deviations of the resting value or rather the signal value when the different sensors (analog or digital) were switched on. As a result the measurements differ from each other and cause an error in the evaluation and determination of the current position. That's why a calibration of the sensors for each measurement is necessary. In the first step of the calibration method an ellipsoid is defined by a free movement of the multi-sensor system so that it is possible to calculate the rest position using the coat identification of the ellipsoidal shell in several points. In the second step we use these points to calculated the 6 parameters of the ellipsoid (x,y,z,r_x,r_y,r_z) with the approximation of the least-squares. The calculated parameters are the rest and the initial position and characterise the multi-sensor system. However the determination of the rest position is done on the PC at the moment and will be implemented on the sensor system in future.
The main achievement of the calibration is the improvement of the positioning. First we had an error of 10% without calibration and reduced it to about 3% with a non-recurring 3D mechanical calibration and with the automatic calibration we reduced the error to 1.5 - 2%.
To sum up the positioning error is less than 2% of the determined position due to the automatic calibration of the sensors at each system activation. This allows to detect the exact position of a person in a room inside a building.

KEYWORDS: wireless sensor network (WSN); embedded systems; sensor calibration and validation; person tracking; inertial navigation system and inertial measurement unit