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Hybrid navigation system for minimally invasive surgery-Phase I: offline sensors calibration

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Minimally invasive surgery (MIS) is not currently widely used by surgeons due to its cost and complex training requirement of surgeons. As a first step towards making MIS a more accessible technology to use is to provide the surgeon with quality images inside the patient as well as the surgical tool location automatically in real time in a common reference frame. Then provide real time suggestions of how to navigate inside the human body in order to follow the pre-operation (pre-op) path. The objective of this paper is to build a platform to accomplish this goal. A set of three heterogeneous asynchronous sensors is proposed to help the surgeon navigate surgical tools inside the human body. The proposed system consists of a laser range scanner (LRS) to emulate the CT/MRI whose image is used to generate the pre-op path by the surgeons, an electromagnetic tracking system (EMTS) that provides three dimensional position and orientation of the surgical tool inside the human body, and a small size camera attached to the EMTS to provide real time images. This set of sensors provides all the necessary information needed for MIS navigation. The sensors have different data rate, different reference frames, and independent clocks. A prerequisite for successful navigation is to represent all the sensors data in a common reference frame. The focus of this paper is on off line calibration of the three sensors, i.e. before the surgical device is inserted in the human body. This is a pre-requisite for real time navigation inside the human body. The proposed off line calibration technique was tested using experimental laboratory data. The accuracy of the calibration process was promising with an average error of 0.1081 mm and 0.0872 mm along the x and y directions, respectively, in the 2D camera image.

Biography

Ali T Alouani works as a Professor in Department of Electrical and Computer Engineering at the Tennessee Technological University. He completed his Ph.D. in Electrical Engineering from the University of Tennessee Knoxville in the year 1986.Dr. Alouani developed and taught many undergraduate and graduate courses in the Systems and Signals areas. To date, he has published 120 technical journal and conference papers. He holds 4 patents. He has been active in many areas of Electrical & Computer Engineering. His theoretical research includes Stochastic Systems, Sensor Data Fusion, Artificial Neural Networks and Fuzzy Systems, Robust Control, Power Systems Stability & Control, Independent Component Analysis.

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