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Data fusion algorithm for indoor navigation based on multi-sensor approach

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ABSTRACT

Reliable and robust navigation are necessary requirements for any autonomous system in real world scenarios. A portable system for indoor navigation in unknown environment is presented, which provides precise information about its local position and orientation in real-time. The system is based on a multi-sensor approach with a basic configuration including an inertial measurement unit (IMU) combined with a tilt sensor respectively a stereo camera system. Both, inertial and optical data are fused in real-time using a Sigma-Point Kalman filter (SPKF). The implemented estimation algorithm is based on a direct state-space formulation. For an indoor application the achieved navigation accuracy is validated due to ground truth data.

An often underestimated problem is the complex alignment procedure for the complete sensor system. Only the knowledge of rotational and translational transformations between the different sensors makes it possible to assign their measurements to the corresponding frame of reference. To determine the rotation between the camera and the IMU or the tilt sensor a static registration procedure is presented. For the identification of the translation between the sensors a dynamic registration procedure is proposed.

KEYWORDS: data fusion, navigation, indoor, multi-sensor, registration