Extrinsic Calibration between 3D Laser Range Finders and Pinhole Cameras Aided by Inertial Data

N. Rodrigues, R. Rocha and J. Dias
Institute of Systems and Robotics
Department of Electrical and Computer Engineering
University of Coimbra, Polo II
3030 Coimbra (Portugal)
{nrodrigues | rprocha | jorge}@isr.uc.pt*

***Abstract*—The use of laser range information and cameras is increasingly common in the navigation application for mobile robots. The combined use of 3D Laser Range Finders (LRF) and cameras enables the autonomous mapping of environments by mobile robotic platforms. The integration of laser range information and images requires the estimation of the Euclidean 3D transformation between the coordinate system of the LRF and that of the camera. In this paper, we describe a method to perform the extrinsic calibration between a 3D LRF and a pinhole camera with the aid of inertial data. While state of the art calibration procedures require a large number of points for robust calibration, our approach presents certain innovations that improve the flexibility and range of application. In particular, we make use of inertial information to provide additional constraints on the association of data from the laser range finder and the camera. The proposed method is based on the presentation of a stationary planar board containing a checkerboard pattern, to a sensor platform consisting of a LRF, mono camera and an inertial sensor. While the camera detects the corners in the checkerboard pattern, association of the 3D points from the LRF is achieved by detecting the edges of the board. The homography between the LRF and camera is achieved using a commonly used least-squares estimation algorithm. The inertial information provides the transformation between successive positions of the sensor platform. As shown by experimental results, while the performance of the described method is not improved as compared to state of the art methods, the applicability of the method is greatly expanded, requiring attachment of a simple inertial sensor to the sensor platform.**

Index Terms - 3D Laser Sensors, Laser-Camera Calibration, Inertial Sensors