

Systems for multisensor navigation and 3D-modelling

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Application of autonomous vehicles mostly relies on pose estimation and 3D environment modelling. In robotics this task is described by the acronym SLAM (Simultaneous localization and mapping). Since these two steps are not mutually dependent on each other and in order to cover a wide range of applications it was decided to separate the research activities.

For navigation a multisensor sensor approach was chosen to assure an accurate and reliable state estimation by Kalman filters. Main sensors are stereo cameras and inertial measurement units, which can be supplemented GPS. In general, data of sensors providing translation or rotation information or their derivatives can be involved. Optical navigation approaches are used to detect and track image features and to derive pose information from camera data. Calibration and initialization (determination of offsets, alignments, camera properties) of the multisensor navigation system are essential for high quality solutions.

3D modelling of the environment is executed by applying stereo cameras and calculating depth maps. The high-performance SGM algorithm was implemented in different hardware systems (GPU and FPGA) in order to provide real time capability for medium resolution images. Again, calibration is one of the key requirements for a successful application.

Combination of 3D modelling and multisensor navigation results in improvement of the quality of the retrieved information or even in new products, e.g. 3D models can be georeferenced only, if navigation data are available.

The paper gives an overview about basic technologies and methods on the topics multisensor navigation and 3D modelling and illustrates the capabilities of autonomous vehicles using this knowledge.