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Autonomous Mobile Robot by Stereo Vision

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Thesis Outline

We developed an autonomous mobile robot that operates by stereo vision alone. Our localization method is implemented on a mobile robot with few resource requirements. Localization by stereo vision is a challenging problem. Our method uses disparity images with the use of high-resolution stereo vision. From the disparity images, we detect road surfaces and extract objects based on their height from the road surface as main localization cues. We set three levels of heights from the road surface in the objects detection. The accuracy of translational motion is improved by the detection and use of brightness feature points in addition to the objects. Inter-frame matching and map matching are performed by the same likelihood in disparity space. By the detected objects and the estimated motion by the inter-frame matching, a map which stores the objects is built. During autonomous traveling, localization is performed by referring the map. By using Field Programmable Gate Array (FPGA), we can resolve the computational issue and build a system with low power consumption to a small mobile robot. We performed the experiment of the autonomous mobile robot.

Forward obstacle and lane detection are necessary for automobile application. To realize an automated driving system, we also developed the forward obstacle detection system by stereo vision. Stereo vision is able to detect both obstacles and traffic lanes. The developed system employs FPGA-based stereo processing system and CPU processing. In the experiments in real environment, the self-lane is recognized at distances up to 80 m, and obstacles in the lane are also detected. Although the error in the obstacle distance increases at larger distances, it is acceptable 1.5 m at 80 m.