Abstract

Simultaneous Localization and Mapping (SLAM) is a navigation method for autonomous vehicles lacking Global Positioning System data and uses only on-board sensors to map the environment and localize the vehicle's position within the environment. Monocular Simultaneous Localization and Mapping (MonoSLAM) is a branch of SLAM in which the only sensors used are an inertial measurement unit and a single visual camera that is capable of measuring bearings to objects within the environment. Since the initial development of SLAM (circa 1986), several papers have been published in which the authors attempt to optimize the performance of SLAM by generating an optimal path for the vehicle to follow. MonoSLAM is a much newer algorithm (first developed in 2007 by Davison, Reid, Molton, and Stasse); no optimization work has been done specifically for MonoSLAM.

This thesis examines a simplified two-dimensional MonoSLAM simulation; no hardware component exists. The author details an optimal path generation (OPG) method designed specifically for MonoSLAM. In MonoSLAM, the vehicle gains useful data when it can detect a change in bearing to objects in the environment (also known as features). The OPG in question maximizes parallax among all visible features in the environment. When comparing paths from this OPG method with paths typically used in MonoSLAM, it is evident that the OPG method produces extremely large fuel savings (up to 98%). This fuel savings comes at the expense of some estimation accuracy; however, the OPG method still produces acceptable estimation performance.