Cooperative estimation for feature-based SLAM

Tim Woodbury

In simultaneous localization and mapping, a vehicular agent creates a map of perceived landmarks in its environment while localizing itself relative to said landmarks. In this paper, two agents operate in a purely planar workspace. The agents share landmark measurements to improve estimation accuracy. Sharing is effected by equipping each vehicle with sensors that measure the relative range and bearing to other agents. The preliminary results presented consider only the localization problem, in which landmarks are sensed but have *a priori* known locations. Each agent constructs an Extended Kalman Filter of its own position and translational velocity, and uses a nonlinear measurement model to incorporate landmark measurements made by itself and by the other agent. Estimation effectiveness is considered in Monte Carlo simulations. Two scenarios are considered; one in which landmark range and bearing is sensed, and one in which landmark bearings only are measured. Interagent measurements are available in both cases, and the performance of agents with and without measurement sharing is compared. Simulations are conducted at varying sensor variance levels and with varying feature densities to gain insight into when this cooperative estimation scheme offers greatest benefits. All simulations consider two agents only; however, the architecture presented does not require the estimation of any additional states, and the only computational burden added by cooperation is a larger measurement vector. This scheme should be extensible to larger teams of agents, limited by only interagent communication bandwidth and relative agent sensing.