Abstract

It is well accepted that the data association or the correspondence problem is one of the toughest problems faced by any state estimation algorithm. Particularly in robotics, it is not very well addressed. This paper introduces a multidimensional assignment (MDA) based data association algorithm for the simultaneous localization and map building (SLAM) problem in mobile robot navigation. The data association problem is cast in a general discrete optimization framework and the MDA formulation for multi-target tracking is extended for SLAM using sensor location uncertainty with the joint likelihood of measurements over multiple frames as the objective function. Methods for feature initialization and management are also integrated into the algorithm. When clutter is high and features are sparse, the compatibility information of features of a single measurement frame is not sufficient to make effective data association decisions thus compromising performance of single frame based methods. However, in a multiple measurement frame approach the availability of more than one frame of measurement provides for more effective data association decisions to be made as consistency of measurements are looked at in several frames of measurement. Simulations are conducted to verify the performance gains over the conventional Nearest Neighbor (NN) data association algorithm, and the Joint Compatibility Branch and Bound (JCBB) algorithm, especially in the presence of varying densities of spurious measurements and dynamic objects. Experimental results with ground truth are presented to demonstrate the practicality of the proposed data association method in complex and large outdoor environments and its effectiveness over single frame based NN and JCBB schemes.