Abstract

In this thesis, we propose a new distributed sensors-based multi-target geolocation and tracking technique. The proposed technique is a joint time-of-arrival (TOA) and direction-of-arrival (DOA) factor graph (FG) for multi-target geolocation (FG-GE), which is further combined with another FG for extend Kalman filtering (FG-GE-EKF) for tracking. Two-dimensional (2D) and three-dimensional (3D) scenarios are considered. In the FG-GE part, a new sensor association technique is proposed to solve the matching problem, which makes the correct correspondence between the DOA/TOA information gathered by the distributed sensors and each target. With the proposed sensor association technique, the measured signals from targets can adequately be matched to their corresponding FGs. Thereby, the multi-target geolocation can be reduced to multiple independent single target geolocation. In addition, in the 3D scenario, each target is projected onto three orthogonal planes in the (x, y, z) coordinate. With the projection, the 3D geolocation is decomposed into three 2D geolocation problems. In the FG-GE-EKF part, the whole tracking system can be divided into two steps: prediction step and update step. In the prediction step, the predicted state is obtained from the previous state. Then, we utilize the predicted state as *a* prior information, and also to update the message exchanged in FG-GE. In the update step, the estimates obtained by FG-GE are regarded as observation state which is used to refine the predicted state, and to acquire the current state. With proposed the FG-GE-EKF, the position estimation accuracy and tracking performance can be improved dramatically, without requiring excessively high computational effort.

Keywords: Factor graph (FG), time of arrival (TOA), direction of arrival (DOA), geolocation, extend Kalman filter (EKF), tracking, sensor association.