Abstract

Recently, there is a tremendous increase in usage of multi-camera set-up in many applications such as surveillance, smart homes, sports analysis etc. Since manual analysis of videos in multi-camera set-up is tedious and inefficient, there is a need to develop automatic computer algorithms to analyze and understand the videos. In many of the applications mentioned above target tracking plays a crucial role. Tracking is the process of following a target continuously and consistently throughout the camera network.

The first part of the thesis develops distributed (where cameras co-operatively work together) single and multiple target tracking algorithms for overlapping camera networks. The target tracking problem is modeled as dynamic state estimation problem and uses sigma-point information filters with probabilistic data association to estimate the state of the target. A complete distributed algorithm is developed by integrating sigma-point filters with average consensus algorithm. For multiple targets, to deal with measurement uncertainty, we introduce measurement-to-measurement association preceding state estimation where we use homography constraints.

In the second part of the thesis we consider target tracking in non-overlapping camera networks. Target tracking in non-overlapping camera networks involves two stages: intra and inter-camera (re-identification) tracking. We identify the key differences between traditional re-identification problem and re-identification in tracking applications. The re-identification in tracking is different and challenging compared to traditional re-identification due to: I) The open-set nature of the gallery II) Dynamic and smaller gallery set III) Rank-1 performance demand and IV) Multi-camera set-up. A novel evaluation protocol for re-identification for tracking applications is proposed considering the above mentioned special characteristics. Also, we propose an on-line update scheme of a metric learning algorithm (KISSME - Keep It Simple and Straight forward MEtric), to improve the re-identification performance.

Finally, we consider person-of-interest (PoI) tracking algorithm in non-overlapping camera networks. In PoI tracking a single person is chosen among many persons in a camera and the task is to track the PoI continuously and consistently across the camera network. We propose two solutions, one using person-specific metric and other using person-specific features (using Recurrent Neural Networks).

The effectiveness of the proposed algorithms is demonstrated through real-world data experiments.