Bayesian tracking of theatre actors

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Context

This internship is proposed as part of an ongoing project on automatic analysis and notation of theatre performances (1) which requires "offline tracking" of actors over long periods of time (2). While the problem of online tracking of multiple targets has been extensively studied in computer vision, much less work has focused on offline tracking. This internship will investigate a Bayesian approach to offline, multi-target tracking in this special and demanding context.

Objectives

The goal of this Master's thesis will be to track a large number of actors on a stage using a single video recording of a theatre performance. We will use actor-specific detectors to obtain noisy estimates of the possible positions and orientations of all actors on stage.

Due to lighting conditions, these detectors are sparse, noisy and unstructured in term of trajectories or behaviors. The goal of the system will be to identify the most likely trajectories and behaviors of all actors during the entire duration of the performance in a probabilistic framework.

The originality of the project will be to extend the use of Bayesian filters (3,4) to cases where information about the future is at hand. Traditionally filters are used to refine the knowledge about the state of a system only using past measurements. In this application we consider an action which is already terminated and we plan to use both past and future information to evaluate, a posteriori, the successive states of the system in time.

The first part of the study will aim at obtaining robust tracks for all visible characters. Bayesian occupancy filters will be modified to track all the characters using past and future informations. The same problem will be tackled globally, possibly using dynamic programming techniques for recovering maximum a posteriori (MAP) trajectories of actors in the Bayesian framework and by using probabilistic boundary conditions which comes from the size of the stage.

The second part of the study will consider behavior recognition using a small vocabulary of stage actions (enter, exit, show, hide, sit, stand, lie, fly). In that case, higher-level HMM will be used to identify the behaviors (5). Again they will be adapted to the offline case by considering past and future observations.

References

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