Color-based Real-time Recognition and Tracking

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Abstract:
Robust real-time tracking of non-rigid objects is a challenging task and is required by many vision applications such as augmented reality, smart rooms or surveillance. Particle filtering has already been proven very successful for non-linear and non-Gaussian estimation problems. However, for the tracking of non-rigid objects, the selection of reliable image features is essential.

We propose to use such a particle filter with color-based image features in comparison to the edge-based image features which have typically been used. The integration of color distributions into particle filtering has many advantages for tracking non-rigid objects as color histograms in particular are robust to partial occlusion, are rotation and scale invariant and are calculated efficiently.

Based on different known histograms, objects are distinguished from each other and tracked in real-time with the proposed framework. The recognized objects can either be identified by a superimposed label with the name of the target or can be replaced by an artificial object.

Keywords: real-time tracking, color filtering, object labeling

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Storyboard:

The real-time tracking software is running on a Linux-computer which is connected to a SONY DFW-VL500 camera. The capturing software is able to grab 15-30 frames per second which are used as input for the tracker.

Two windows are opened by the system, one shows the live video stream of the camera while the other one displays the tracking results and is used for the user interaction. The operator marks an object of interest with the mouse pointer on a snap-shot of the scene. The selected target model which is described by the color-histogram of the marked region is then used for the recognition as well as for the tracking process.

For the recognition, color-histograms of a fixed number of objects are recorded and managed in a database. An object is recognized on the basis of a similarity measure between the target and the stored histograms. The proposed framework is using the Bhattacharyya coefficient, which is a popular similarity measure. The larger the coefficient for two distributions is, the more similar they are. Consequently, the target can be recognized by means of this values and a label specifying the name of the object is assigned to it.

As particle filters are based on sample sets, these elements are strategically placed at positions where the target is expected to appear. Each hypothetical object state is represented by a region respectively its underlying color-histogram. If a fraction of samples shows a high enough Bhattacharyya coefficient during initialization, the object is considered to be found and the tracking process is started. Likewise, the same rule is used to determine if an object is lost during the tracking.

For the tracking process the sample set is propagated and updated over time to find the most probable sample distribution. As a result the mean state of such a sample distribution can be displayed, the corresponding label of the target can be superimposed or the target can be replaced by an artificial object.

The proposed demo framework has real-time capability and can be tested easily for several objects and by different users.