Title: Non-linear feature extraction for object tracking in cameras networks

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Abstract

Thanks to their advantages, high efficiency and big data streams, camera networks have been widely used for public security and surveillance. Recently, with the deployments of a series of security infrastructure, the public security industry around the world has established large-scale video surveillance networks, which play a vital role in improving management of urban safety and maintenance of social stability. Large-scale video surveillance networks not only contribute to social development, but also bring issues of mass surveillance data. In this PhD thesis, we aim to focus on two different functionalities of a smart videosurveillance camera network-based system:

1. Collaborative detection and tracking of a moving target in a wide region covered by non-overlapping networked cameras.
2. Automatic detection of abnormal situations in public places.

The work will be done in collaboration with a local team of PhD students, Postdoc researchers and a start-up company working in smart video-surveillance.

I. Tasks description

I.1 Collaborative image processing in camera networks

One of the objectives of a camera network is to detect and track a target moving in an environment under surveillance. The ability of the surveillance system to detect an intruder, in an automatic way, is very important for security purposes. Visual tracking usually consists of two steps: the first step is representing the target as a reference model in the form of feature descriptors; while the second step is inferring the best location matching with the reference model, in the current frame. However, in the location procedure, it is challenging to prove whether a candidate box involves the true target or not. This can be simply explained by the unstable appearance of the target through time. Typically, in the human tracking case, the non-rigid object model (size, shape, color, etc.), the irregular movements and the frequent occlusions require more robustness of the tracker. Also, the unstable model makes hard the re-finding of the human target in different non-overlapping camera views (see Fig.1). Moreover, a time delay may interrupt the continuity of an objects position over time, causing the failure of the tracker. Hence, when distinct images of objects are captured without enough temporal or spatial continuity, the re-identification process becomes the convenient approach to maintain the tracking [10].

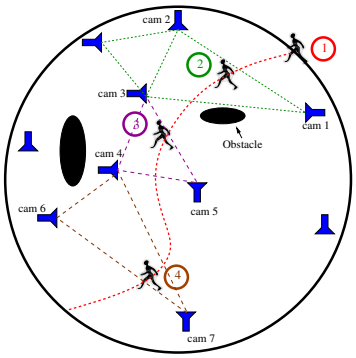

Fig.1. The layout of camera networks

Without complex pre-calibration in a wireless camera networks, we aim, in this thesis to design a collaborative visual tracking framework based on combining nonlinear classification methods and Bayesian filtering [1--4]. Taking into account the bandwidth constraints, while ensuring a robust decision making, is one of challenging aspects in designing in-network video processing algorithms and robust multi-view visual descriptors [5].

I.2 Video stream-based abnormal detection

The tracking algorithm is generally initiated by a human action or by applying some simple rules as the object detection in forbidden regions delimited by the operator. In this project, we aim at making this decision automatically taken by the smart camera. The tracking process is initiated when the camera detects an abnormal behavior based on the real-time analysis of the video stream. The abnormal behavior is defined as the deviation from a normal behavior assumed to occur during a certain period. In other words, the camera considers a predefined period as describing the normal behavior of the scene. This database could be improved by integrating some situations considered to represent some dangerous abnormal situations. The objective of the on-line implemented algorithm is to efficiently and timely detect any abnormal situation (for example, abnormal group movements in crowded scenes, see figure 2 for some instances of abnormal group motion in public places and preliminary results based on SVM algorithms proposed in [6,7]).

Figure 2. An example of an abnormal movement detection in a public place.

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