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3-D geometric Reasoning in Security Applications

3D scene analysis is the new frontier of advanced video surveillance systems, including real time detection and control as well as off-line intelligent video analysis. It is particularly important to perform automatic detection of significant alarm events and reduce the overload of direct human supervision and control of a large number of video cameras all-together. The paper will refer a number of application examples of People detection and tracking, vehicle detection and classification, where 3D vision and projective geometry play a fundamental role to enhance video analysis capabilities. The key approach is to perform 3D geometric reasoning directly in the world reference system, by using suitable 3D models for the searched objects (humans, vehicles, etc), and project such models into the different cameras (multi-view system) to verify the presence and position of the targets in the expected position. Camera calibration and target tracking is performed by using projective geometry and projective invariant features (like vanishing points, vanishing lines, cross ratio etc.) to achieve robust and stable solutions in security applications. Some application examples will be referred to prove the effectiveness of the proposed approach:

- 3D People counting and tracking in a crowded scene is achieved by using a binocular stereovision system. By scanning different parallel planes of the 3D world (using homography transformations) it is possible to achieve real-time processing capabilities by focusing onto the relevant features of the scene.
- Soccer player tracking is another interesting example of a complex scene analysis to show the potential of a multiple camera system with partial overlapping views.