E_WP4: Context-driven Behaviour Monitoring and Anomaly Detection

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Abstract

We focus specifically on the problems of using electro-optic (video, IR, LiDAR) and audible data to monitor behaviour and detect anomalies. Building on recent work in audio-video tracking, we propose to use audio-video features to detect anomalies that are visually indistinguishable from normal behaviour. In combination with social context models, we will show that subtle and social anomalies can be detected, and that tracking can be improved by feeding back behaviour inference to low-level tracking algorithms.

Early results

Collaborative work with Roke Manor has shown that human behavioural anomalies can be detected in crowded scenes. Anomalies include running through a scene, loitering, and suspicious movement/bag swap.
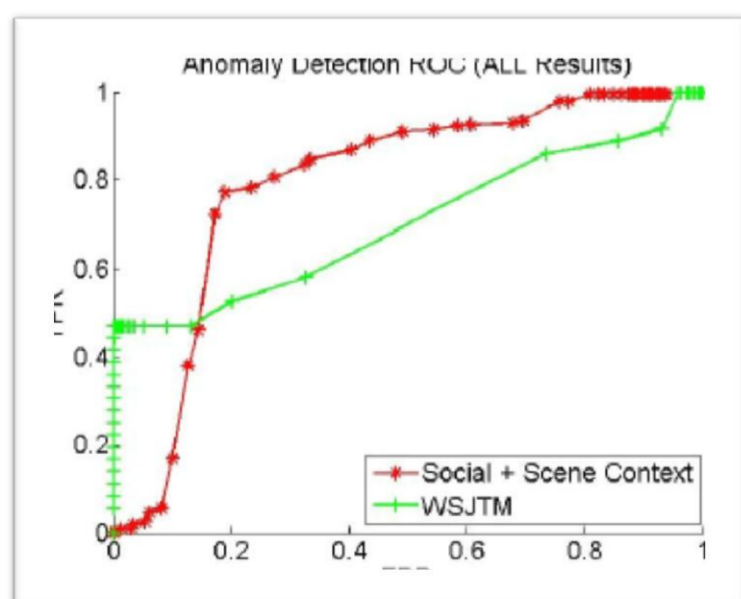
A comparison of the approach against the Weakly Supervised Joint Topic Model shows that by using both social and scene context we can significantly out-perform the current state-of-the-art.

The importance of context

- Spatial context (e.g. person at rear of vehicle) has proven beneficial for anomaly detection in complex scenes

- Similarly, social context can identify anomalies that are otherwise indistinguishable from normal behaviour

- Trackers typically predict object movement based solely on trajectory history

- This ignores important behavioural information (e.g. target destination, collision avoidance), which could be used to anticipate changes in trajectory

Convoy monitoring from an airborne platform

- Convoy behaviour can be monitored autonomously from sensorised platforms

- Spatial and social context allow for better behavioural inference, facilitating tracking in complex environments. For example:
  - Typical convoy response to a road block
  - Simplified tracking of 'follow the leader' manoeuvre

- Social context allows subtle anomalies to be detected (e.g. 'civilian' convoy approaching)

Enhanced situation awareness

- A vehicle with mounted optics sensor system (Lockheed Martin)

- Detection of subtle anomalies at checkpoints and public places. For example:
  - Abnormal 'gazing' at objects, people or cameras

Research objectives

- Use advanced social models (e.g. gazing, scene context) to improve group tracking in crowded scenes

- Detect social anomalies, with defence, homeland, and retail security applications

- Utilise other modality data features (e.g. audio) to detect and re-enforce anomaly detection from non-visual cues