

# Efficient Safety and Security in Crowded Environments

## CENTAUR

Crowded ENvironments moniTORing for Activity Understanding and Recognition

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### Motivation

- Surveillance systems with hundreds of cameras overload operators.
- Automatic tracking of individuals is limited to non-crowded scenes.
- Major challenge for public safety and security: crowds.



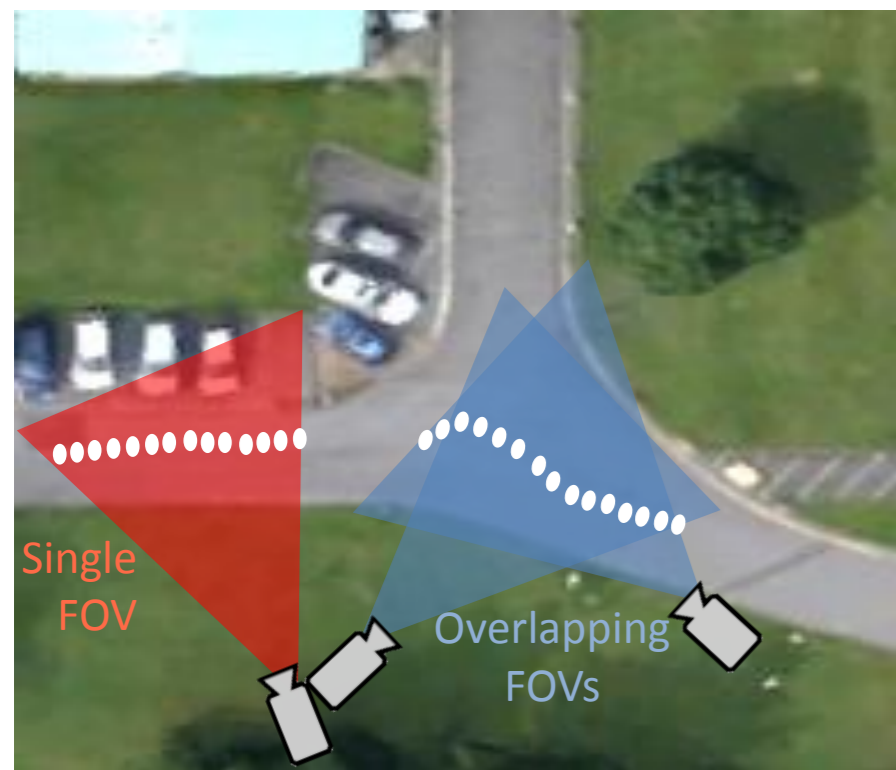
### Tracking & Re-identification

#### Tracking

Algorithm to automatically follow individuals by their appearance and motion using:

- Dynamic Background Subtraction<sup>1</sup>,
- Probabilistic Occupancy Map<sup>2</sup>,
- k-Shortest Paths<sup>3</sup>.

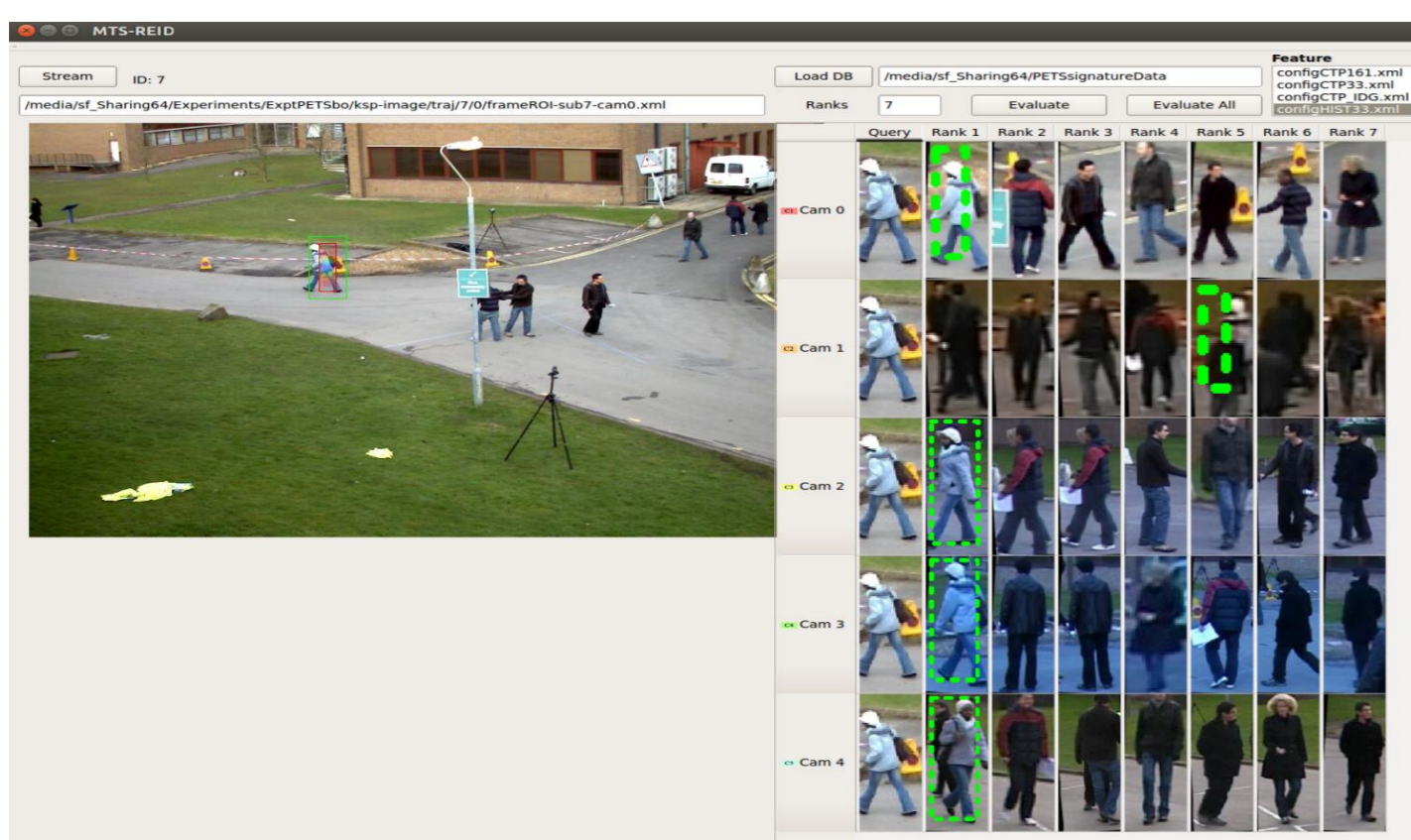
FOV = camera field of view.



Does the same person appear in the blue and red zone tracks?

#### Re-identification

Appearance-based track signatures are compared to facilitate detection of an individual's reappearance. This enables individuals to be tracked across non-overlapping FOVs.



- Graphical User Interface to visualise the likely matching people across the camera network.
- Search space greatly reduced.
- Operators make the final decision.

### Crowd Understanding

- Crowds are highly dynamic, constantly changing in size, density, velocity and direction.
- Crowd analysis cannot be performed with standard tracking algorithms.
- CENTAUR solution highly successful in detecting violence from camera footage.

Approach	Accuracy
Histograms of Oriented Gradients and Optical Flow (Laptev et al., CVPR'08)	56.52%
Histograms of Oriented Gradients (Laptev et al., CVPR'08)	57.43%
Histograms of Optical Flow (Laptev et al., CVPR'08)	58.53%
Local Trinary Patterns (Yeffet and Wolf, ICCV 2009)	71.53%
Violent Flows (Hassner et al., SISM, CVPR'12)	81.3%
<b>Our Approach</b>	<b>93.53%</b>

#### Non-violent Scenes



#### Violent Scenes



#### Ethics & Privacy, an Opportunity?

The CENTAUR project is being conducted against a backdrop of intense debate about the right balance between privacy and security in the Information Age. Our objective is to boost the security operator's situational awareness and to achieve this, absolute identification is simply not required. Furthermore, video analytics actually provide an opportunity to harness procedures such as automated anonymisation or cancellable biometrics.