Research Thrust RA:
Real Time Threat Detection and Mitigation

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So What? Who Cares?

- Command centers for protection of soft targets and crowded spaces can benefit from decision support systems
  - Multiple sources of diverse inputs
  - Significant uncertainty as to status and future evolution of threat
  - Complex decisions with difficult options to evaluate
- SENTRY has a thrust doing research on potential analytics to be used in command centers
  - Will provide a brief overview of these activities
- TRL: 1-2

RA: Real Time Threat Detection and Mitigation

Objectives: Develop decision support systems for enhanced protection of STCPs

RA.1: Real-time Management of Adaptive Surveillance and Mitigation

- Investigators: Mario Sznaier (Project lead, NU), Milad Siami (NU), Stacy Marsella (NU), Richard John (USC), David Castañón (BU)

RA.2: Low Complexity, AI-based Fusion of Crowd-Sourced Heterogeneous Data Streams

- Investigator: Eric Miller (Tufts)

RA.3: Real-time Video Surveillance for Threat Detection and Mitigation

- Investigators: Rich Radke (Project lead, RPI), Octavia Camps (NU), Henry Medeiros (U. Florida)

RA.1 **Real-time Management - Surveillance and Mitigation**

Algorithms for sensor management for multi-function camera networks

- Broad surveillance, detailed ID & inspection
- Motivation: Threat detection, confirmation, alarm resolution, with extension to other sensors

Models of human behavior in active shooter scenarios

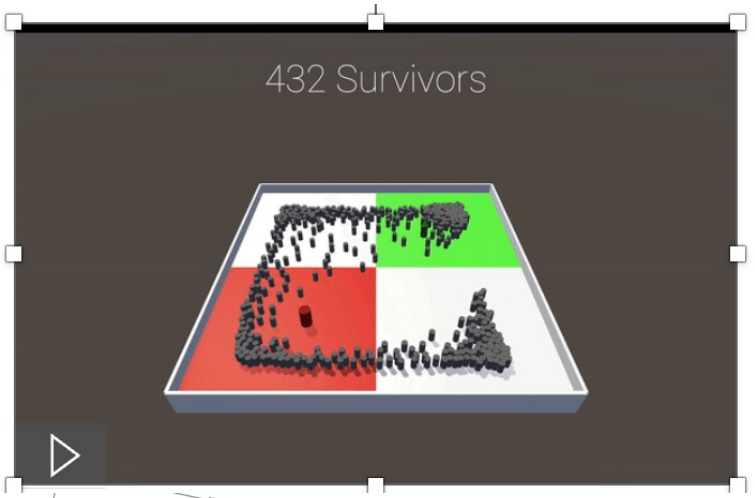
- Human subjects in simulated immersive games
- Key questions: How is individual behavior influenced?
- Goal: integrate behavior into agent models for control design
- Status: experiments designed, about to start

RA.1 Real-time Management - Surveillance and Mitigation

Control algorithms for steering crowds in danger situations with guiding agents: enhancing run-hide-fight

- Extensions of predator-prey agent models
- Goal: reduce casualties through optimizing guidance agent

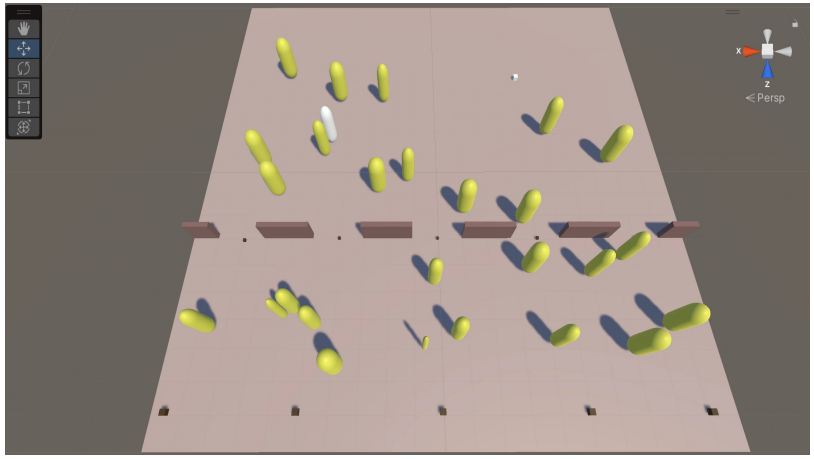
- Network algorithms for planning crowd migration to safe aeras
  - Extension of approaches for vehicle evacuation in disaster areas



RA.2 **Low Complexity Fusion of Crowd-Sourced Data**

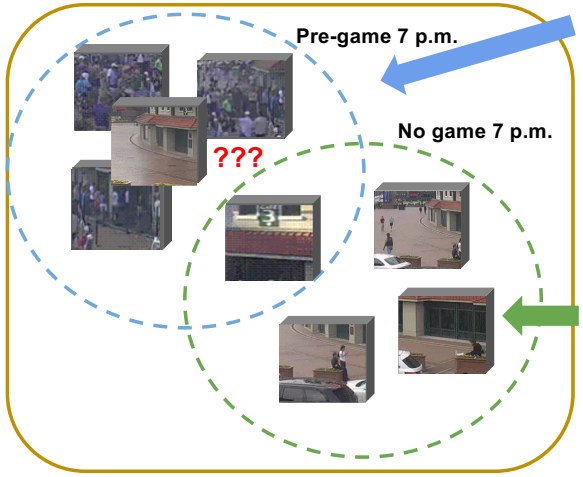
- To address limitations in available data sets, developed synthetic models for generating data from personal devices
  - Exploiting gaming industry tools for simulating crowd dynamics
- Multiple scenarios to motivate research:
  - Bottleneck corridor, Transit platform
- Extensions to exploit data from wi-fi networks in progress

- Transit Scenario
  - Passengers (white)
  - Passengers follow path to assigned train door
  - Non-passenger agents present in scene, affecting passenger motion



RA.3 Real-time Video Surveillance

- Goal: Detect anomalies in crowds with respect to their context
  - Normal activities depend on time, date, environment, … data from public cameras
- Baseline: Models trained for each situation
- New approach: Single model built on modular architecture using memory units



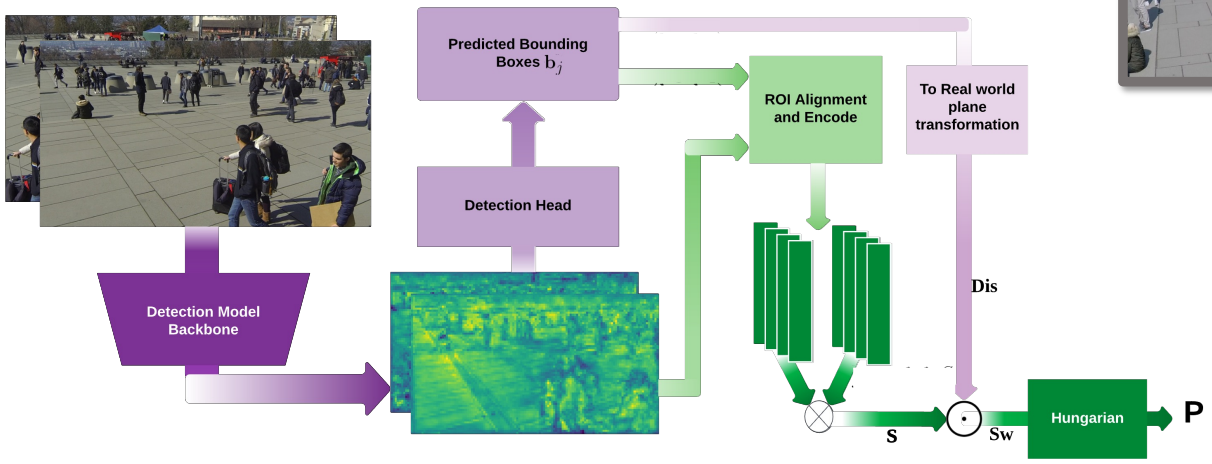
Memory units (puzzle bank)

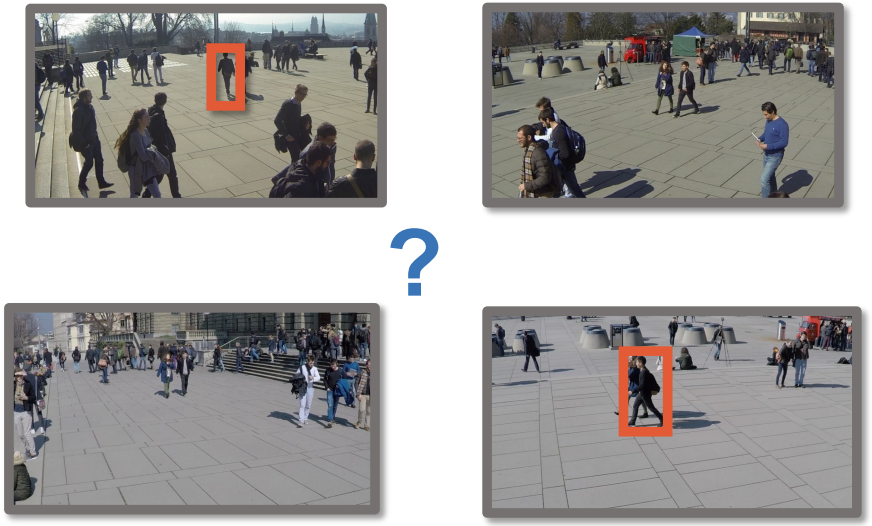
Pre-game 7 p.m.

No game 7 p.m.

RA.3 Real-time Video Surveillance

- Algorithms for camera selection in real-time video surveillance
  - Developed full multi-person tracking algorithm
  - Integrated into framework for camera selection
- Architecture:



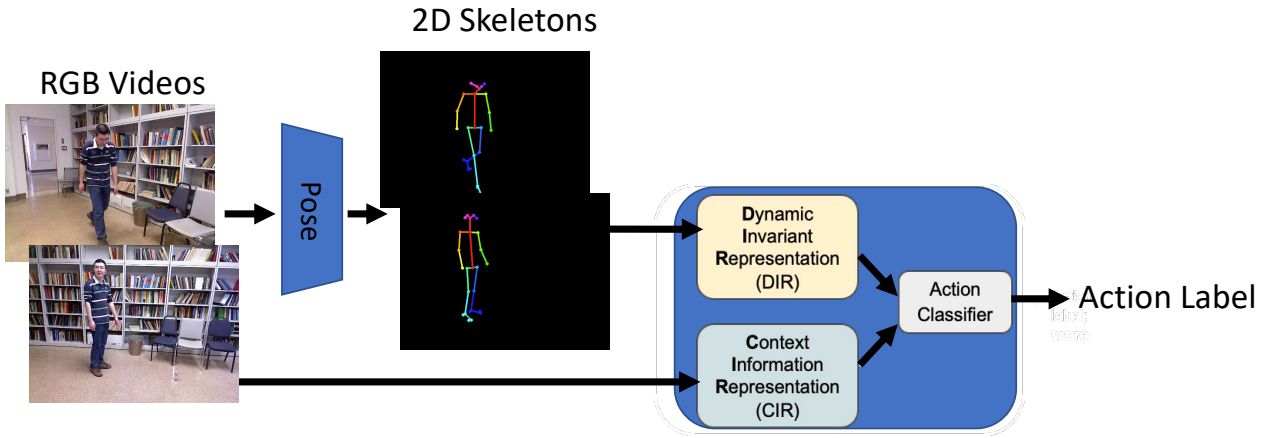


	MODA	Prec.	Rec.	
MVDet	88.2	94.7	93.6	Wildtrack
Ours	94.2	97.1	97.1	

	MODA	Prec.	Rec.	
MVDet	83.9	96.8	86.7	MultiviewX
Ours	92.7	96.3	96.3	

RA.3 Real-time Video Surveillance

- Action recognition using dynamics invariants
  - Challenges: appearance changes with viewpoint, hard to train multi-camera systems from possible geometries
  - Goal: recognize actions in videos from unseen viewpoints in training data
- Approach: Learn dynamics-based viewpoint invariant features from the trajectories of human joints
  - Initial tests show significant improvements over state of the art on academic benchmarks



Dataset	Cross-subject OURS and Previous SOTA	Cross-view OURS and Previous SOTA
N-UCLA	**97.5** (87.5)	**99.4** (83.1)
NTU-60	**97.6** (97.0)	99.4 (**99.6**)
NTU-120	**95.8** (95.3)	**97.3** (96.4)
UWA3D II	-	**84.4** (81.4)

RA Summary

- Many challenges remain
  - Conduct of human subject experiments to refine models
  - Collection of relevant scenarios/data for SENTRY environments
  - Development of real-time algorithms
  - Evaluation of performance tradeoffs in SENTRY-relevant applications
- Connections to Virtual Sentry Framework:
  - Provides the foundations for analytics useful in Command Centers
  - Identifies data, computation requirements for decision support