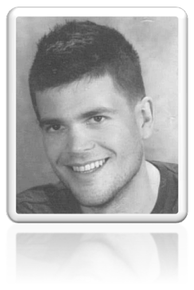
MEDNARODNA PODIPLOMSKA ŠOLA JOŽEFA STEFANA

JOŽEF STEFAN INTERNATIONAL POSTGRADUATE SCHOOL

# Identifying Suspicious Behavior from Multiple Events

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## Problem Statement

**Goal:**

**Detect suspicious behavior from a collection of individual trigger events**

- No single event is enough to decide (no incidents)
- Combination of events enables reasoning

**Main challenges:**

- Trigger events are noisy
- Trigger events involve interactions of multiple agents making recognition under noise difficult
- Our belief that person is acting suspiciously increases with the number of suspicious events non-linearly
- Subject's behavior in the past affects current evaluation

## Where Can It Be Applied?

- Adversary has a motivating goal
- His/her behavior deviates from behavior of regular subjects

**Detect Server Attack**
Observe users' actions to identify individuals who misuse server access.

**Find Pirate Vessel**
Observe how vessels interact with security patrols to identify pirates.

**Catch Dangerous Drivers**
Observe driving maneuvers to identify dangerous/reckless drivers.

**Catch Shoplifter**
Automatize video surveillance in shopping center to detect shoplifting from a series of events.

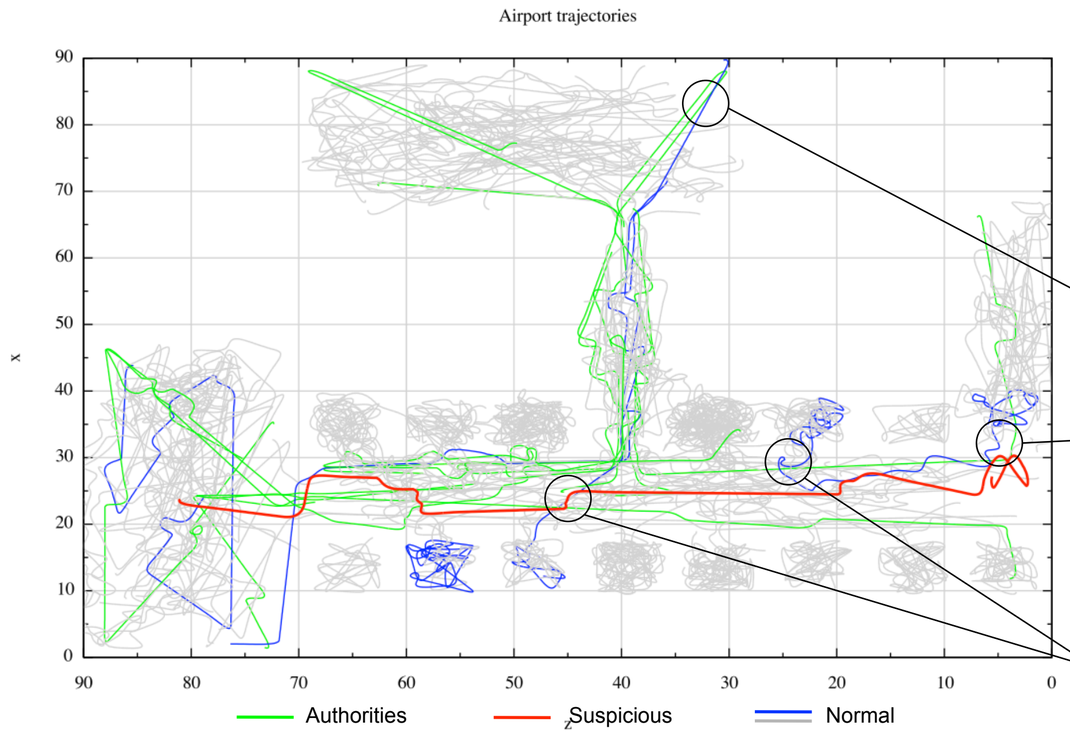
## Example: Detecting Suspicious Passenger at the Airport

**Goal: detect passengers that try to achieve a secured point**

- Go from point A to B (e.g., to smuggle drugs, plant a bomb, gain access…)
- Keep contacts with authorities at minimum
- Scenario defined by airport security experts

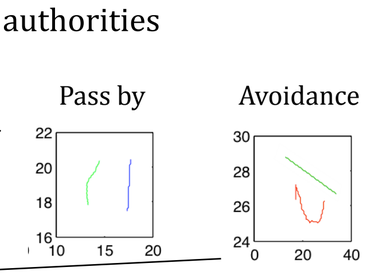
**Input: 2D traces of all passengers**

- Produced by multiagent simulator ESCAPES
- Find suspicious passenger (red trace)




**Trigger events**

Interactions with authorities




Detected with Coupled Hidden Markov Models

Turns

Turns in absence of authority


Detected with trajectory curvature

**Results**

- Naïve Bayes detector: recall 90%, precision 41%
- Scoring function: recall 90%, precision 90%

## Detectors

**Bayes-Optimal Detector**

- Optimal detector!
- We have no direct knowledge to estimate parameters
- We need approximate approaches

**Naïve-Bayes Detector**

- Assumes event independence
- Assumes that events are generated by stationary processes
- Model is over-simplified

**Scoring Function**

- Class of *well-behaved* functions
- Well-behaved heuristic function
  - Considers behavior in the past
  - Exponential increase in suspicion
  - Exponential time decay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