



# AVIRES Lab University of Udine

## Sensor Management: A New Paradigm for Automatic Video Surveillance

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# Video Surveillance

- What is video surveillance used for?

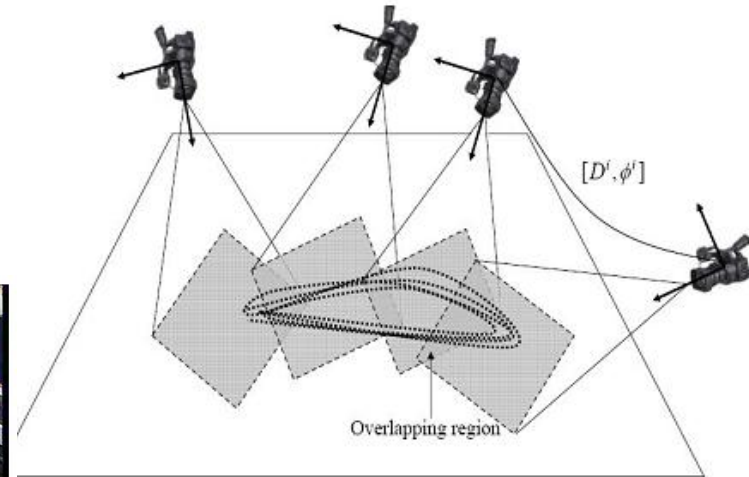
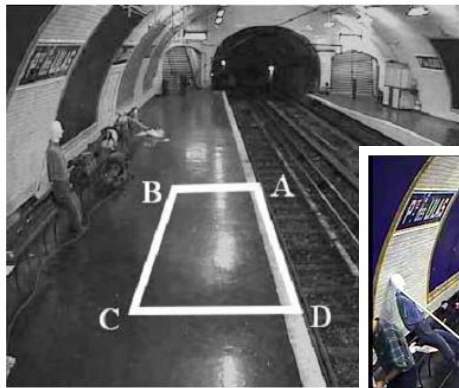
*“Automatic video surveillance addresses real-time observation of people and vehicles within a busy environment, leading to a description of their actions and interactions”*

R.T. Collins, A.J. Lipton, and T. Kanade, “Introduction to the Special Section on Video Surveillance”, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 22, n. 8, 2000



# Applications of VS

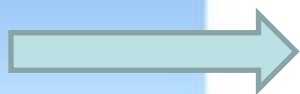
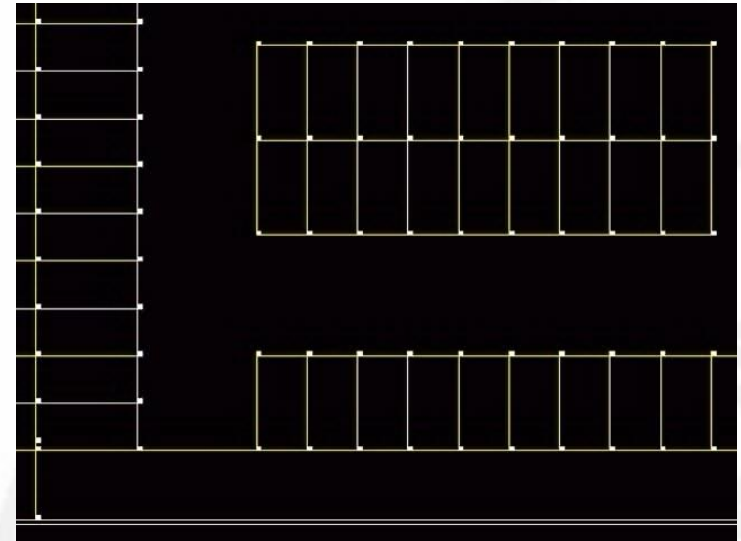
Remote surveillance of unattended stations, level crossings, tunnels, etc.





# Automatic Video Surveillance

- Automatically detect and analyse events in the monitored area to perform:
  - Event logging
  - Suspicious behavior detection
  - Alarm triggering



Trajectory analysis for behaviour understanding



## Automatic Video Surveillance (2)

- There is a growing need for monitoring large areas (shopping malls, parking lots, roads, etc.)
- Outdoors are notoriously difficult to deal with (changing illumination and weather conditions)



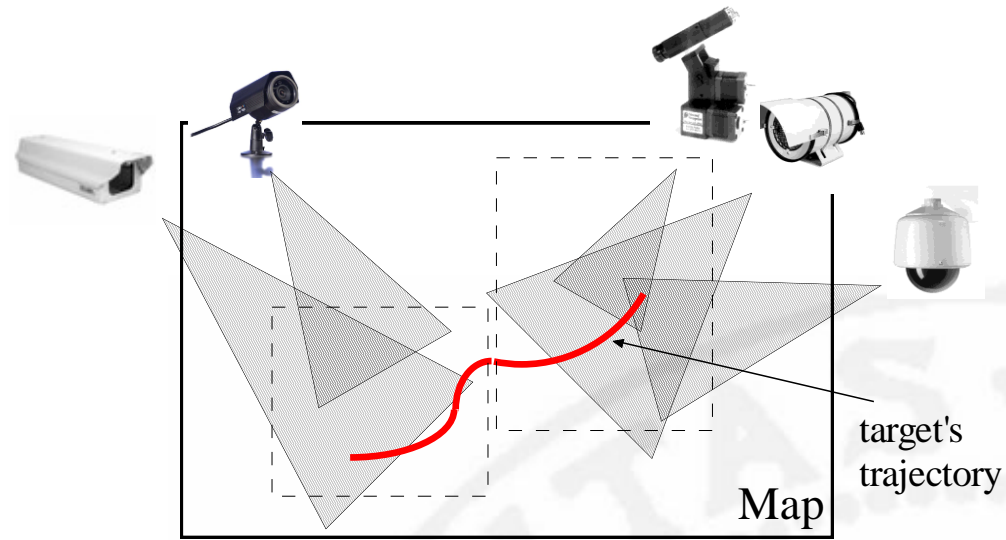
Multisensor systems



# Multi-sensor Systems

Extended Coverage

- Space
- Time



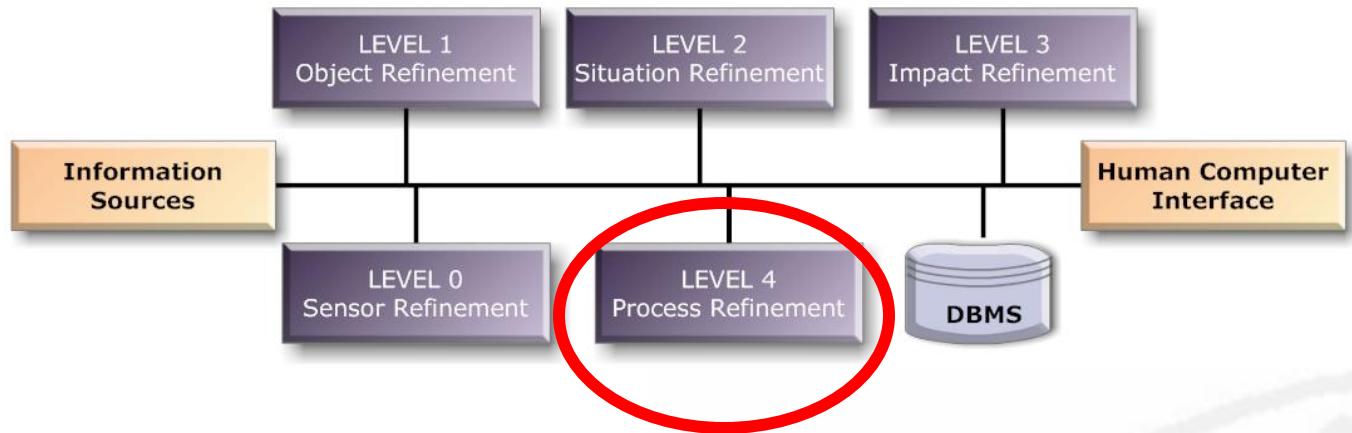


## Multi-sensor Systems (2)

- Multiple overlapping sensors → Sensor Fusion
- **Sensor Fusion:** “is the combining of sensory data or data derived from sensory data such that the resulting information is in some sense better than would be possible when these sources were used individually”.
- Sensor Fusion Advantages:
  - Robustness and reliability
  - Extended spatial and temporal coverage
  - Increased confidence



# Sensor Management



- Process Refinement dedicated to sensors and data sources
- It can be defined as “a process that seeks to manage, or coordinate, the use of a set of sensors in a dynamic, uncertain environment, to improve the performance of the system”

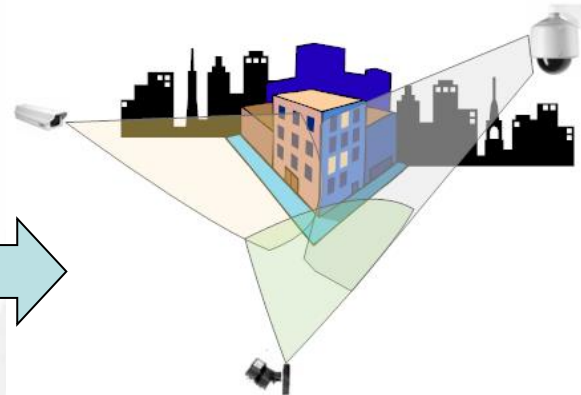




## Sensor Management (2)

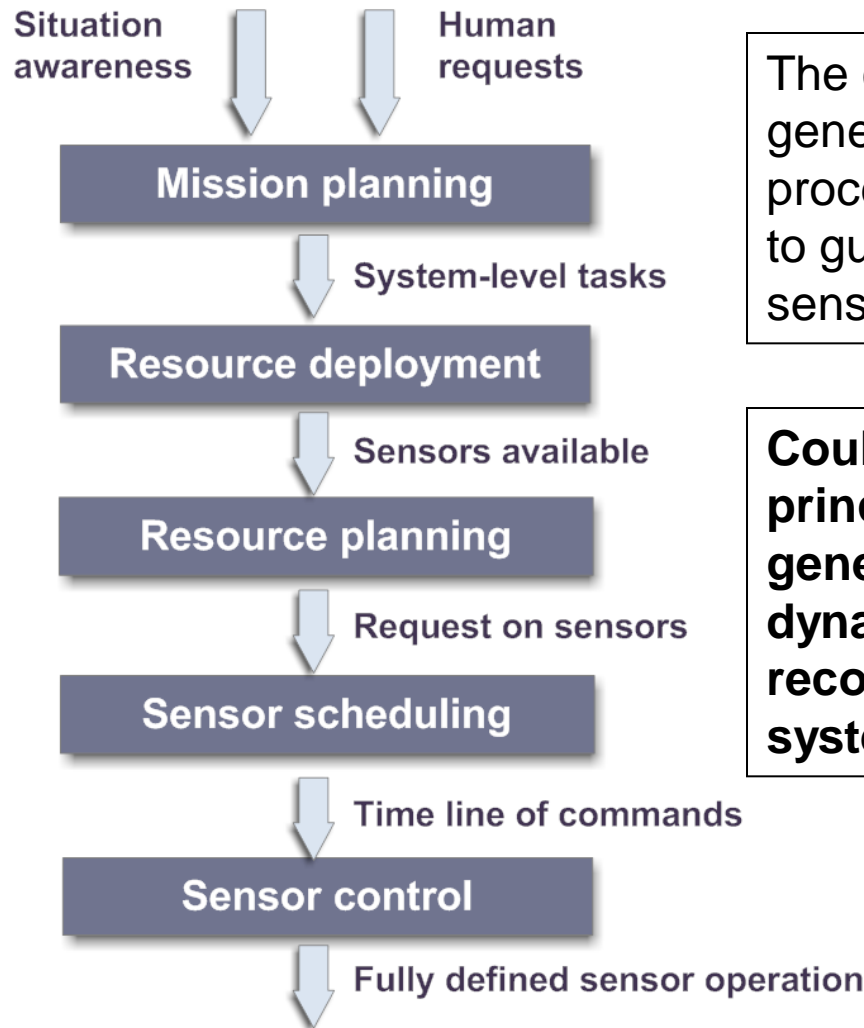
Should be able to :

translate mission plans or human directives into sensing actions directed to acquire needed additional or missing information in order to improve situational awareness and fulfill the objectives





# Levels of Sensor Management



The chart schematizes a general sensor management process that can be used to guide the design of a sensor management module

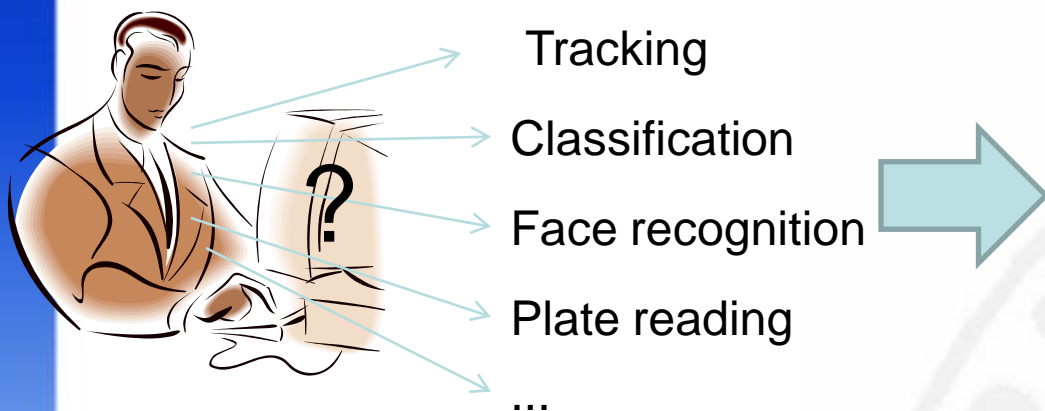
**Could be taken as a design principle of next generation dynamic (automatically reconfiguring) surveillance systems**



# Mission Planning

- Match between operator's requests and available services

## Mission Planning module



## Example:

- Event to be detected: loitering person



# Resource deployment

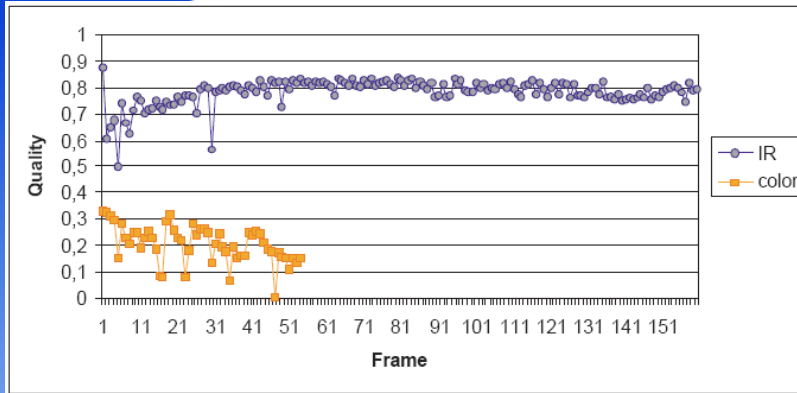
- From mission goal to sensor suite

Mission goal

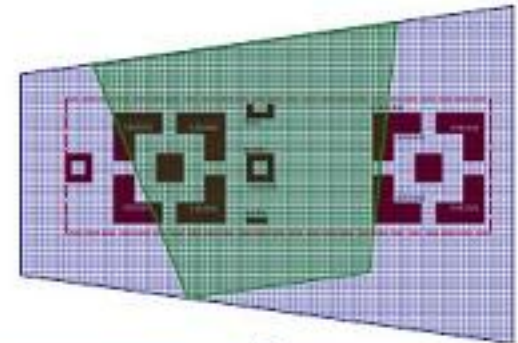


Required sensors to accomplish goal

**Capability**



**Coverage**



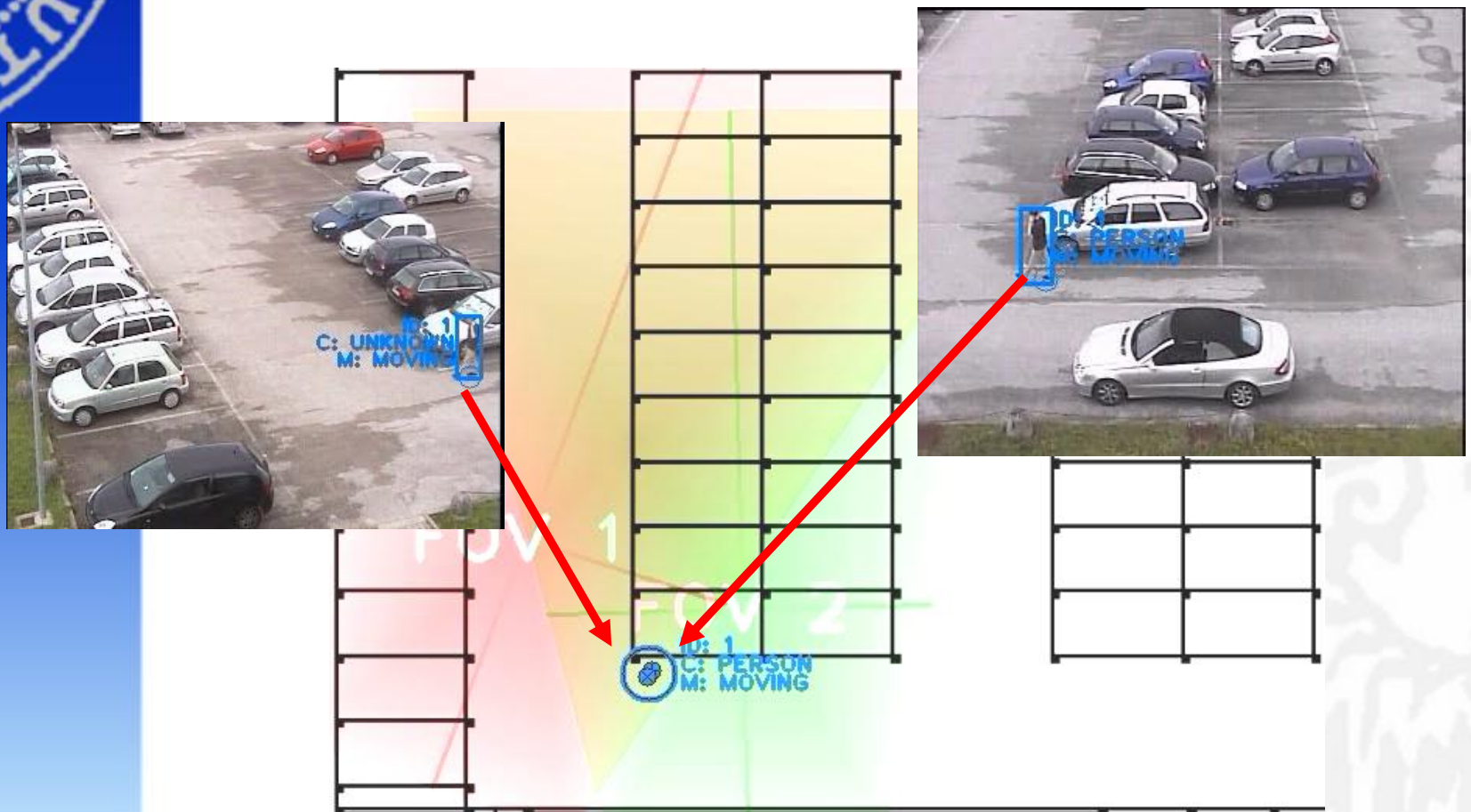
(a)





# Resource Planning

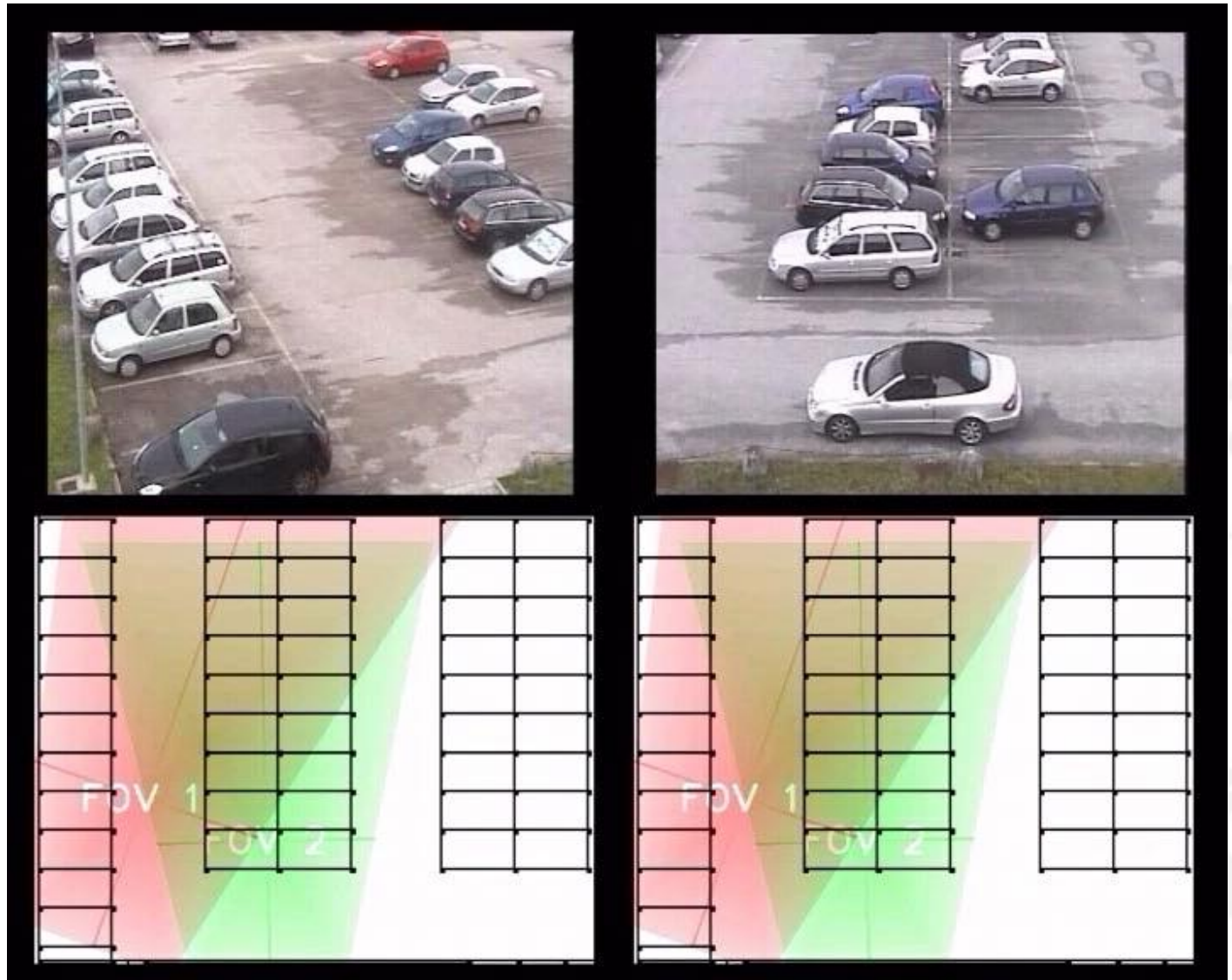
- Sensor coordination to achieve mission goal (e.g. sensor hand-over)





# Resource Planning

- Sensor coordination to achieve mission goal (e.g. sensor hand-over)





# Resource scheduling

- From resource planning to sensors commands
  - Detailed schedule of commands for each sensor
  - E.g. Active sensors, multi-modal sensors





# Sensor Control

- Optimizing sensor parameters given the goal (e.g. iris, focus, contrast, etc.)
- Sensors have different internal characteristics
  - Different response under changing illumination conditions
- Poor detection can have detrimental effects on ground plane localization of targets







# Conclusions

- A combination of heterogeneous sensors can lead to better situation awareness in a surveillance scenario
- Sensor Management deals with the exploitation of sensory data in light of mission goals and contextual information
- Sensor Management should be used in the design of next generation automatic surveillance systems
  - Automatically reconfiguring systems according to goals