People Detection

and Video Understanding

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Video Understanding

Objective: Designing systems for Real time recognition of human activities observed by various sensors (especially video cameras).

Challenge: Bridging the gap between numerical sensors and semantic events.

Approach: Spatio-temporal reasoning and knowledge management.

Examples of human activities:

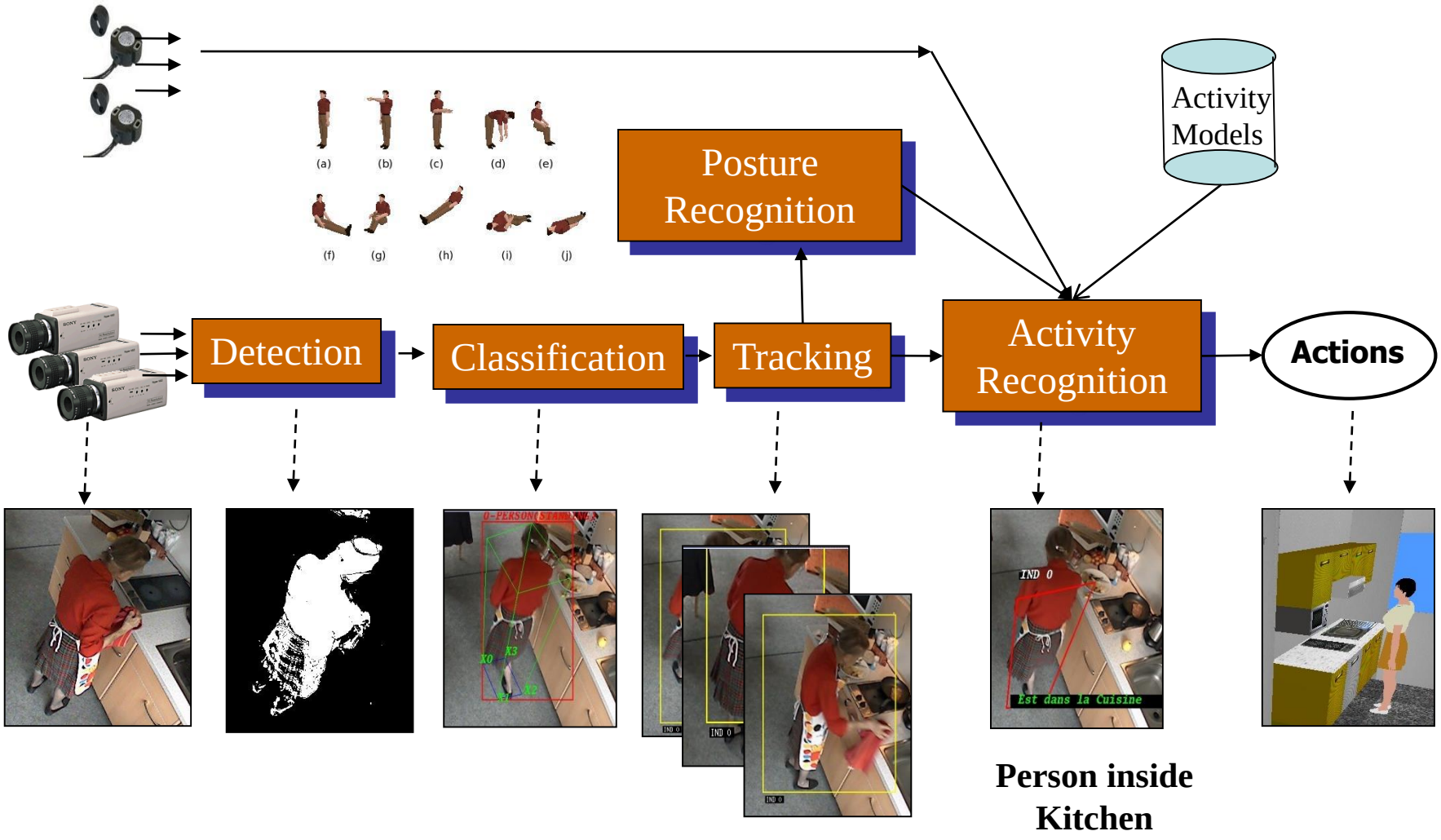
for individuals *(vandalism, bank attack, cooking, washing dishes, falling)*

for small groups *(fighting)*

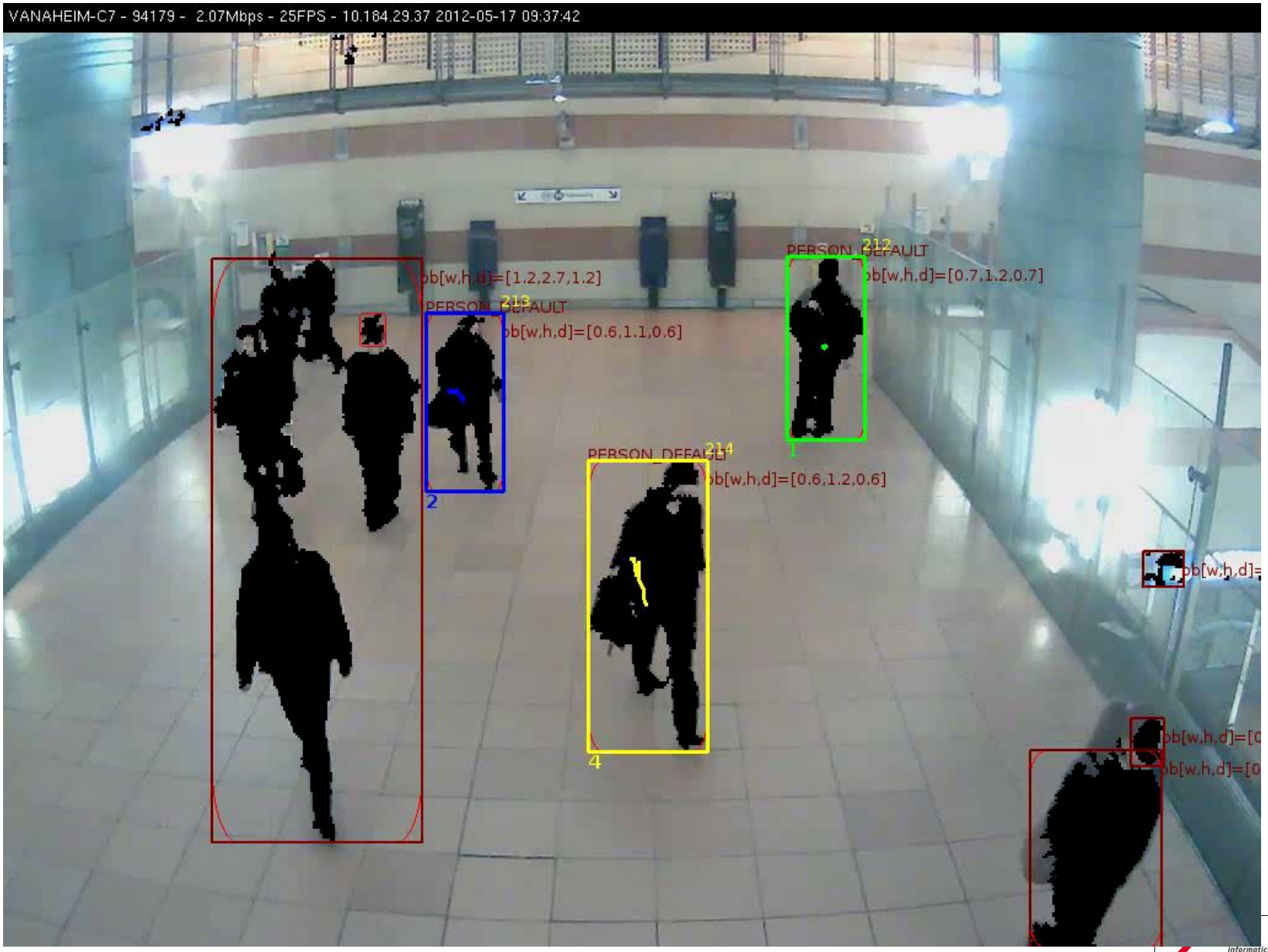
for crowd *(overcrowding)*

for interactions of people and vehicles *(aircraft refueling)*

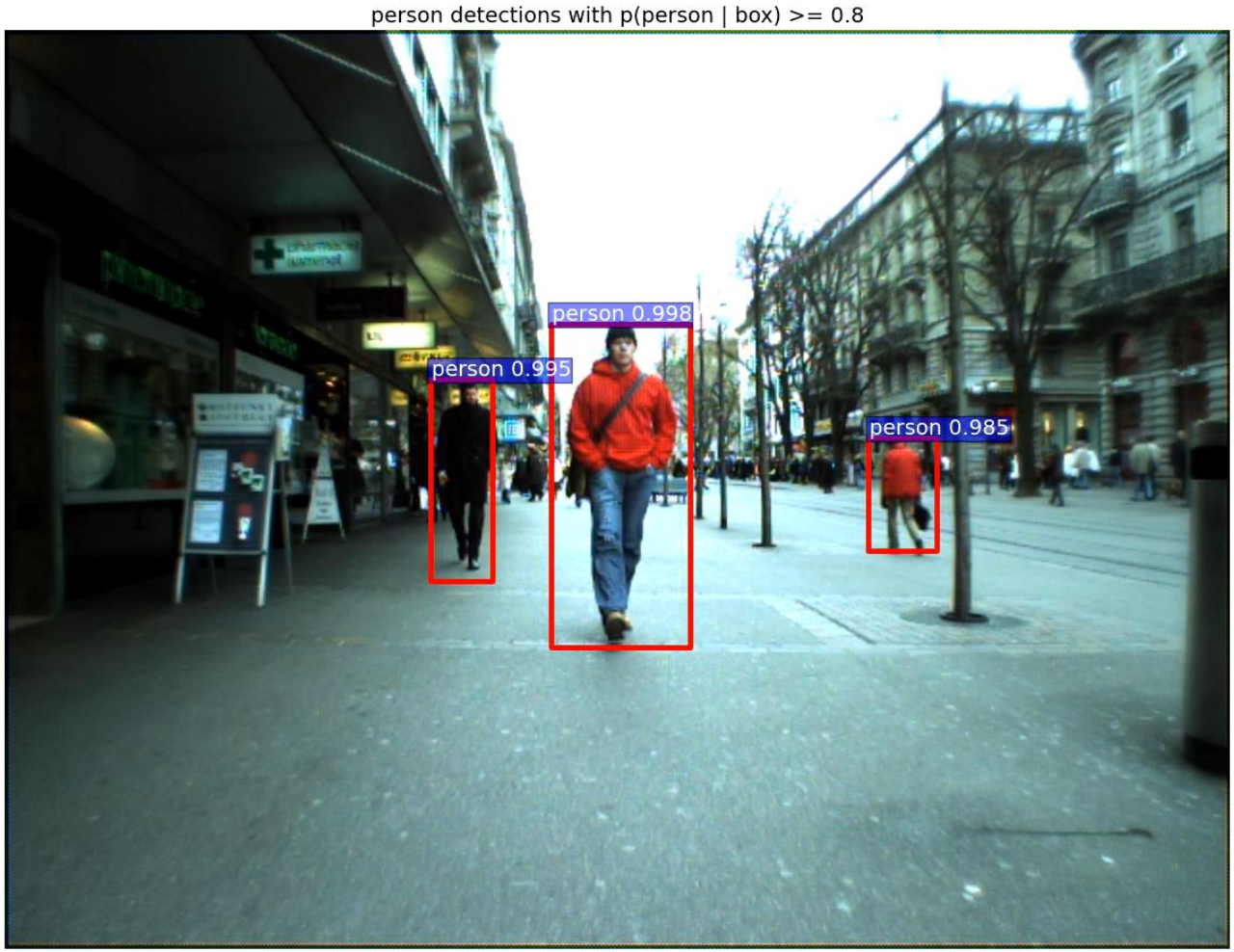
Generic Platform for activity understanding



People detection and tracking



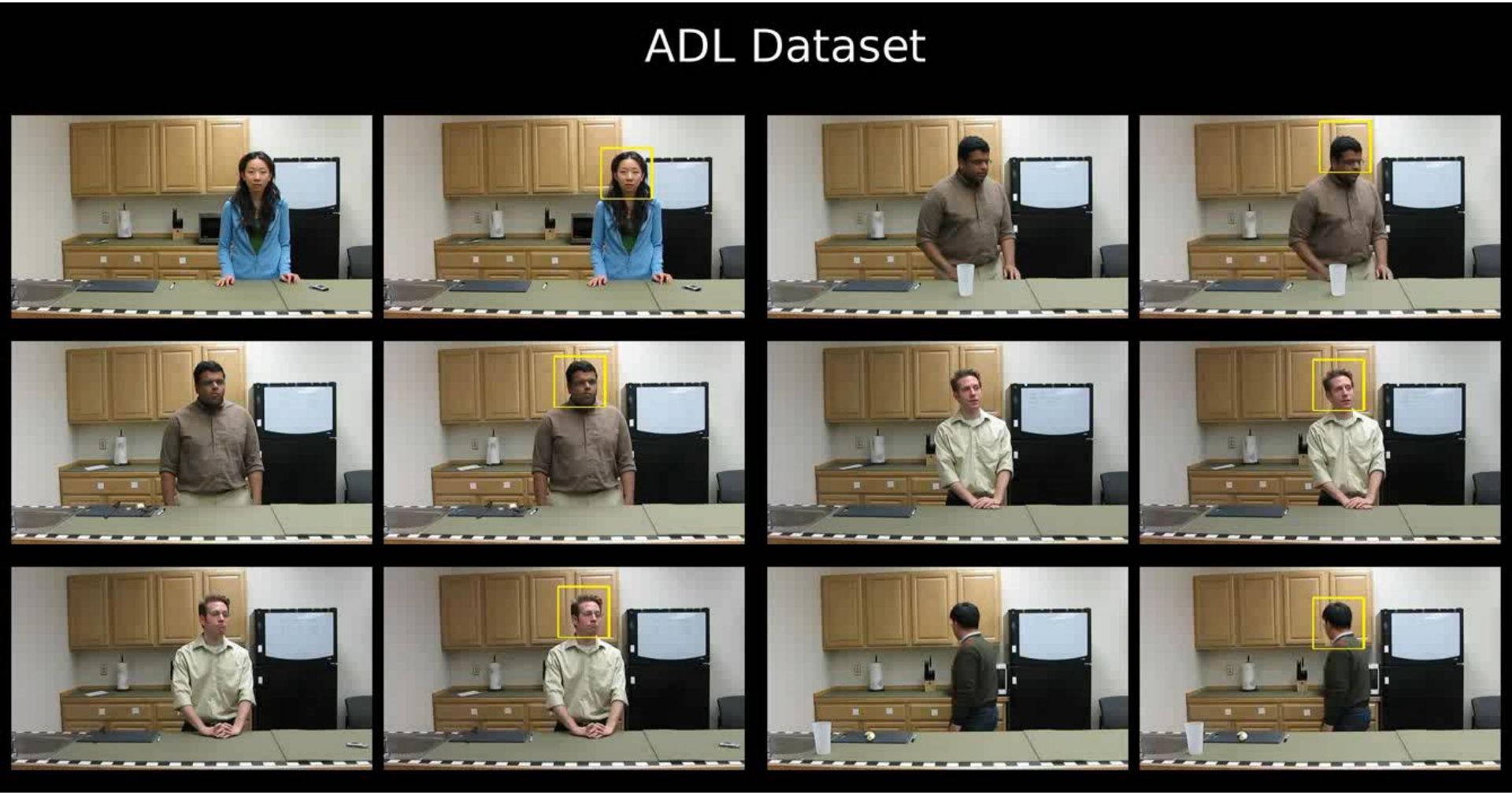
People detection : faster R-CNN on ETHZ



Motivation - Action Recognition
Hollywood dataset

Motivation - Action Recognition
UCF Sports dataset

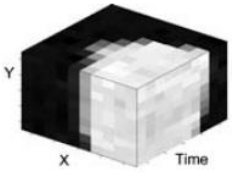
Motivation - Action Recognition
Daily Living datasets (Rochester Univ.)

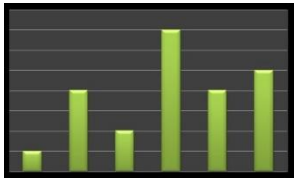
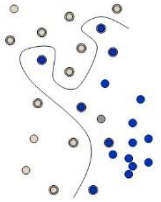


Action Recognition using Bag of Words
M. Koperski

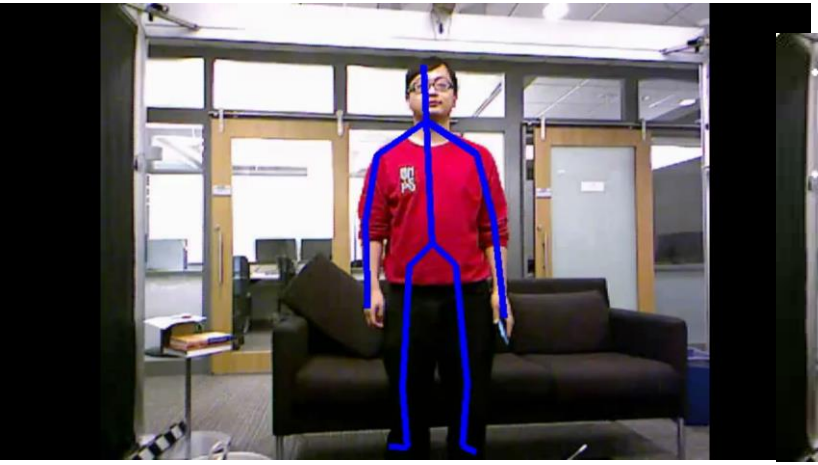
Videos → Feature detector → Feature descriptor → BOW model → Histograms of codewords → Non-linear SVM

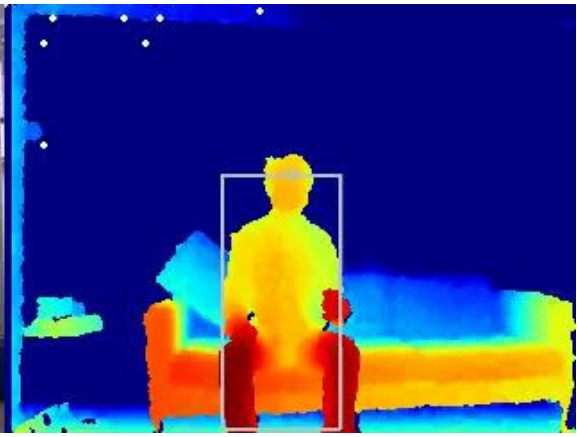




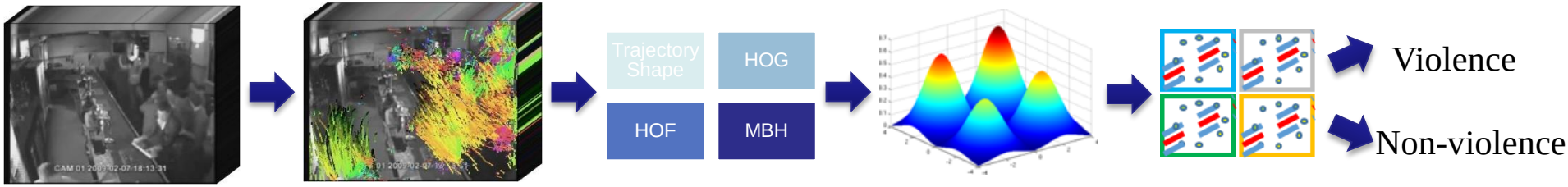




Codeword defined as a Descriptor cluster





Violence Recognition Framework, P. Bilinski



Input Video | Feature Detection (Improved Dense Trajectories) | Feature Description (TS, HOG, HOF, MBH) | Video Representation (Improved Fisher Vectors) | Classification (SVM)

Violence

Pub

Street

Football Stadium

Steet

School

Movies Analysis

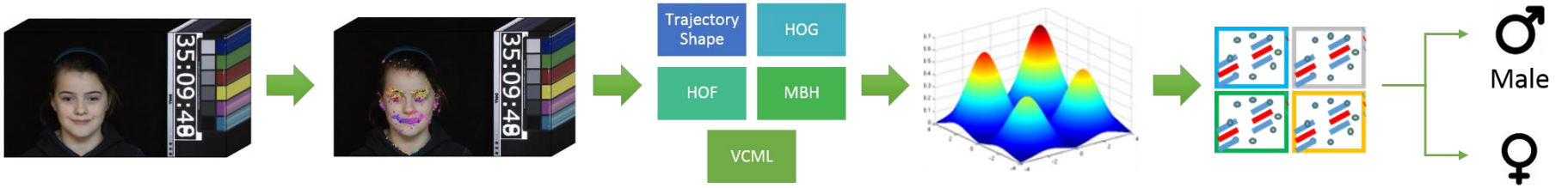
Non-violence

Football Stadium

Football Stadium

Gender recognition using smile: A. Dantcheva

Spatio-temporal features based on dense trajectories represented by a set of descriptors encoded by Fisher Vectors .



Input Video

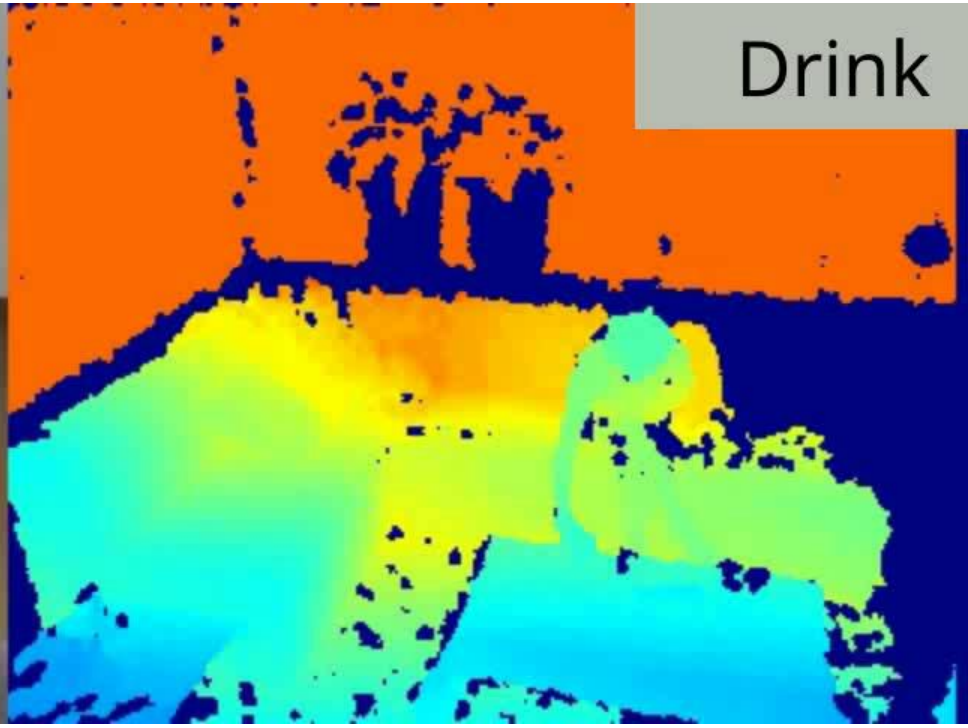
Dense Trajectories (Dense Sampling, Point Tracking)

Descriptor Computation

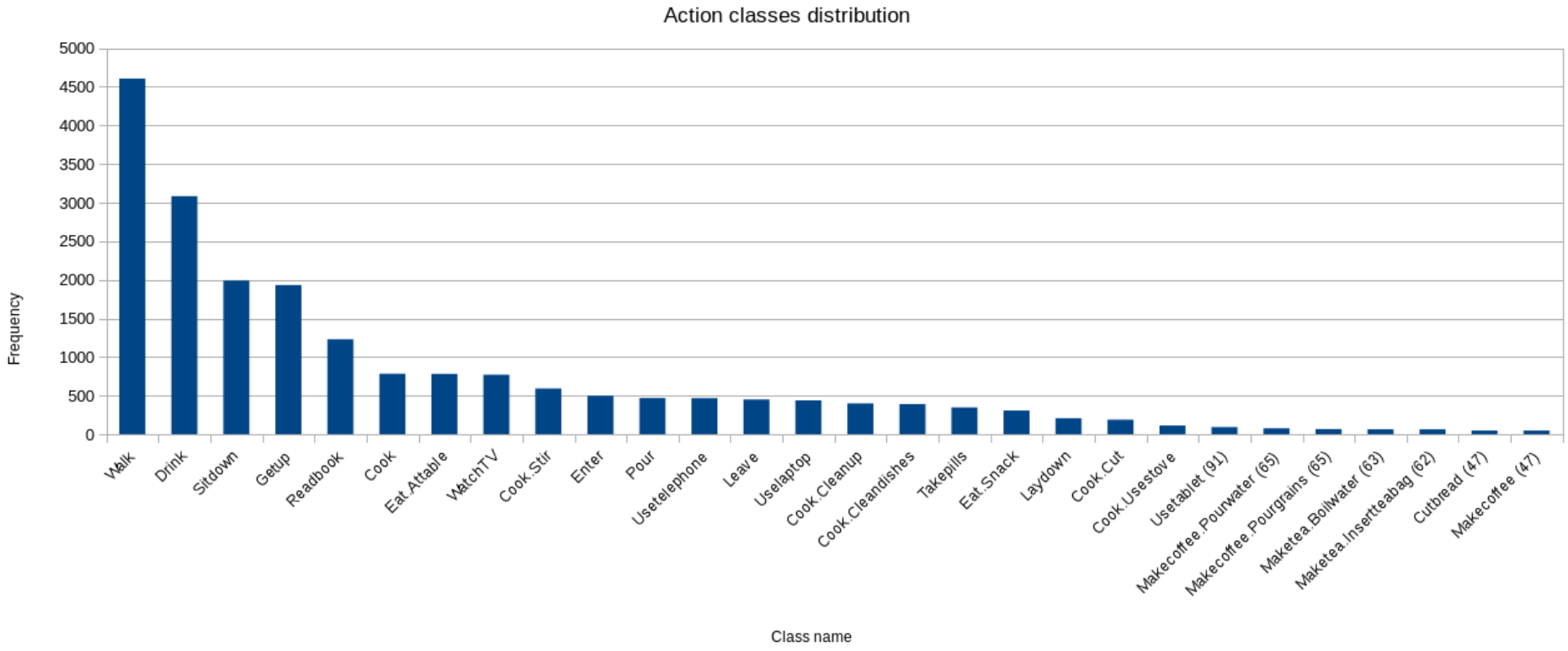
Fisher Vector Representation

Gender Recognition (Classification)

Toyota Smart-Home
Large scale daily living dataset



Toyota Smart-Home
Large scale daily living dataset



Issues in Action Recognition using Deep CNNs

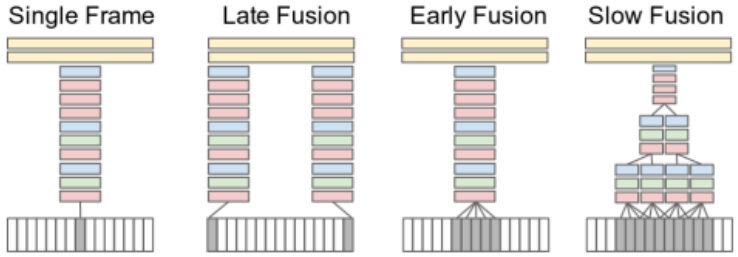
Deep Convolutional Neural Networks (CNN)

Images

- Large Annotated data (Imagenet)
- Architecture Suitable for Images with good resolution

Videos: How to capture motion information in CNN ?

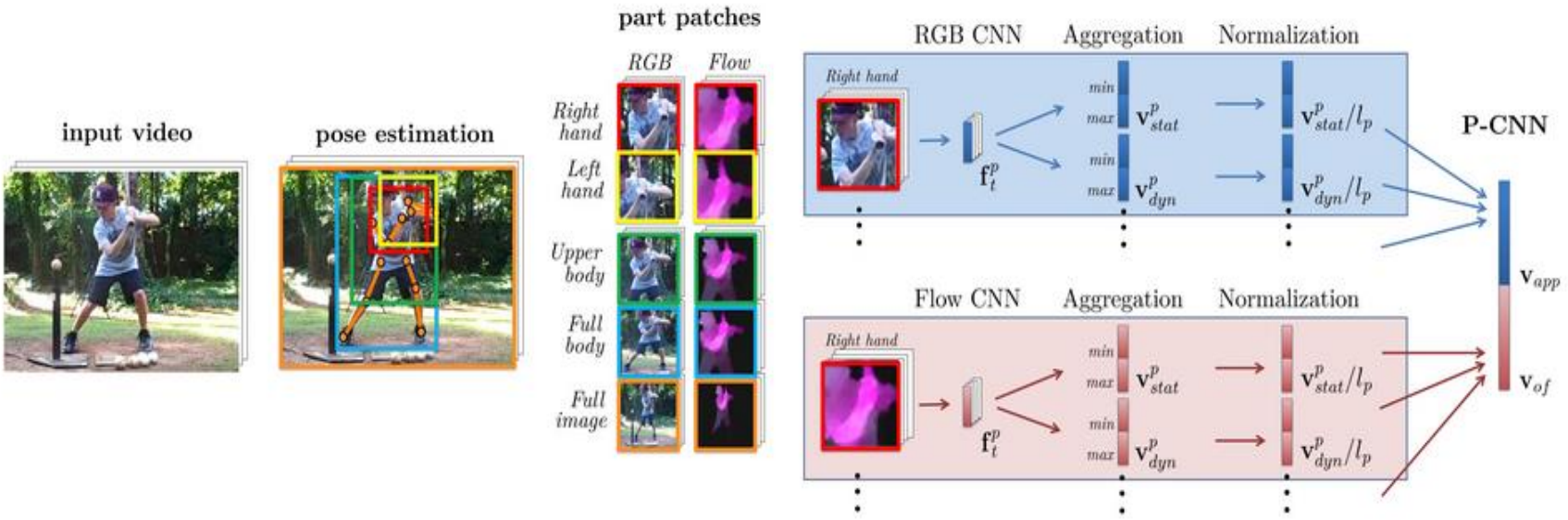
- Stacking of frames



- Capture motion independently or not: several stream CNNs
  - One ConvNet to capture static (frame based) visual information.
  - Another ConvNet to capture motion information (like Optical Flow, but expensive)
  - Other Nets to capture motion on longer scales or together (Siamese)
  - Other Nets to capture object-ness.

C. Roberto de Souza, A. Gaidon, E. Vig, and A. Lopez. Sympathy for the Details: Dense Trajectories and Hybrid Classification Architectures for Action Recognition, ECCV 2016

Convolutional Pose Machines for Action Recognition



- Proposed a representation derived from human pose using *Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields*
- The descriptor aggregates motion and appearance information along tracks of human body parts using *P-CNN : Pose-based CNN Features for Action Recognition*

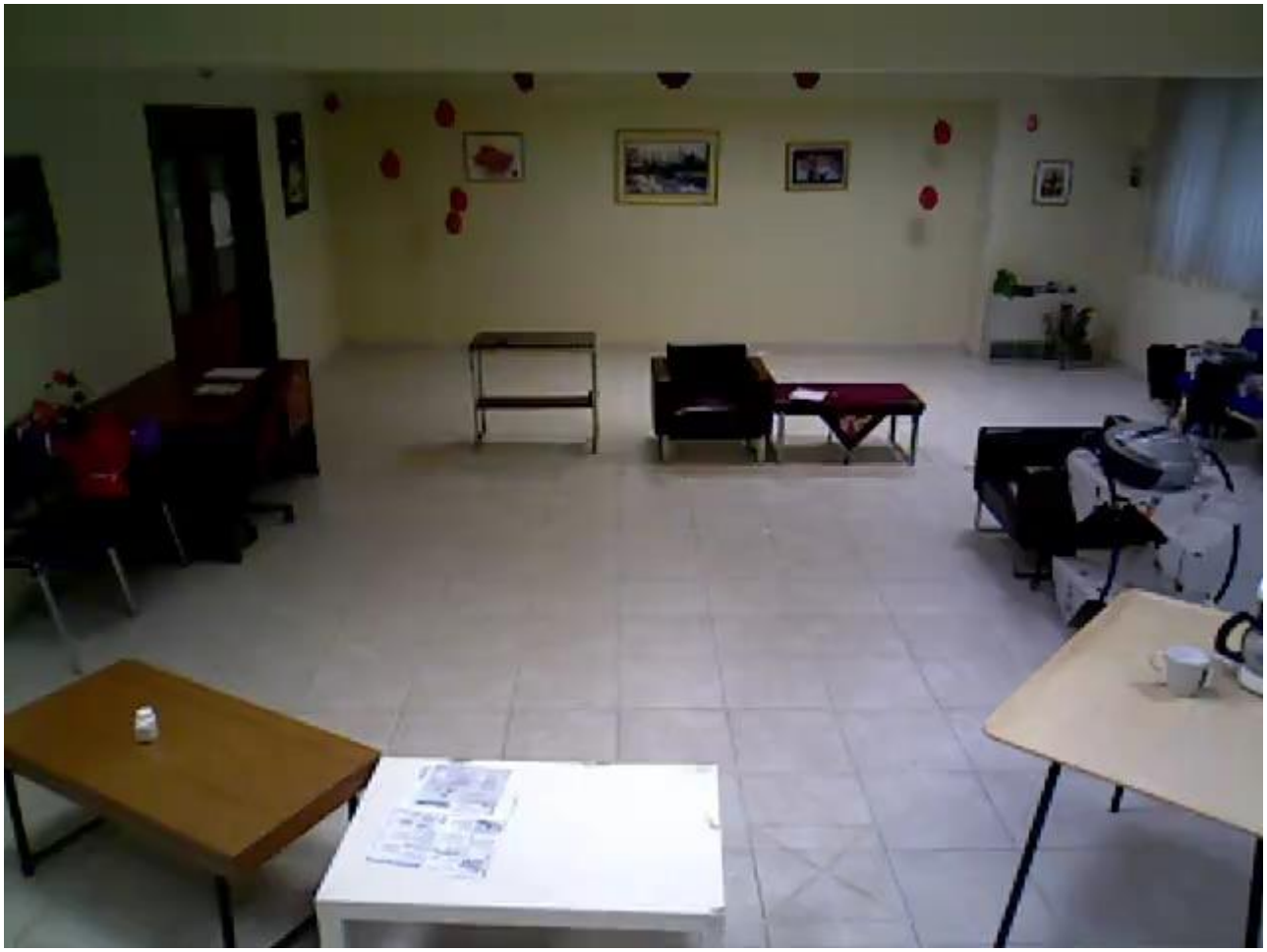
Toyota Smart-Home
Large scale daily living dataset

Pour water for tea

Prepare tea

Activity monitoring in Greece Hospital with AD patients

Visualization of older adult performance while accomplishing the semi-guided tasks.



Conclusion - video understanding

A **global framework** for building real-time video understanding systems:

Perspectives:

- Generate totally unsupervised models
- Use finer features as input for the algorithm (head, posture, facial gesture…)
- Generating language description for the activity models
- Generic activity models (cross scenes), Adaptive learning
- More semantics, emotion, mental states.

4 PhD open topics:

- Kontron: People Tracking using Deep Learning algorithms on embedded hardware
- ESI: People Re-Identification using Deep Learning
- Wildmoka: Video based Action Recognition using Deep Learning
- Nice Hospital: Uncertainty Management and Activity Recognition