



Centre of Research Excellence
for Advanced Cooperative Systems



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ACROSS – – Centre of Research Excellence for Advanced Cooperative Systems

FP7-REGPOT-2011-1 #285939

brief project overview
overview of recent vision research

Siniša Šegvić
UniZg FER



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About UniZg FER

- **About Univ. Zagreb, Faculty of Electrical Engineering and Computing:**
 - 3 years BS + 2 years MS
 - 600 freshmen, 500 MS theses each year
 - International accreditation for Bachelor and Master programs by ASIIN
- **About me:**
 - associate professor, vision researcher
 - PhD courses: Dynamic scene analysis, Models for representing images and video
 - undergraduate courses: Design patterns, Comp. architecture 2, Scripting Languages
 - seminars, projects and theses (BS, MS, PhD)





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ACROSS Global Objective

- Create a long-term sustainable
**Centre of Research Excellence for Advanced
Cooperative Systems**
within UNIZG-FER, which will
 - strengthen research potential of UNIZG-FER,
 - be integrated in ERA and conduct world-class R&D,
 - act as a point of contact between academia and industry in the area of cooperative systems.



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ACROSS Strategic Research Domains

- **Application oriented SRDs:**
 - SRD1: Cooperative Cognitive and Robotic Systems;
 - SRD2: Cooperative Networked Embedded Systems;
 - SRD3: Cooperative Renewable Energy Systems;
- **Fundamental Enabling Technology Domain:**
 - SRD4: Cooperative Control Methods.
- **These SRDs are chosen due to:**
 - UNIZG-FER's Existing expertise
 - The future perspectives of these domains at EU and world level



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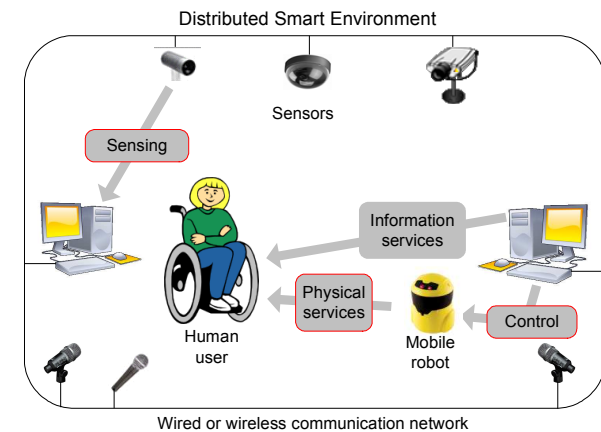
Cooperative Cognitive and Robotic Systems



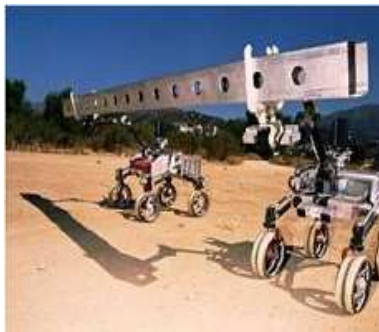
Cooperative Human-Robots Systems



Cooperative Heterogeneous Multi-Robot Systems



Robots Embodied in a Distributed Smart Environment



Cooperative Load Transportations

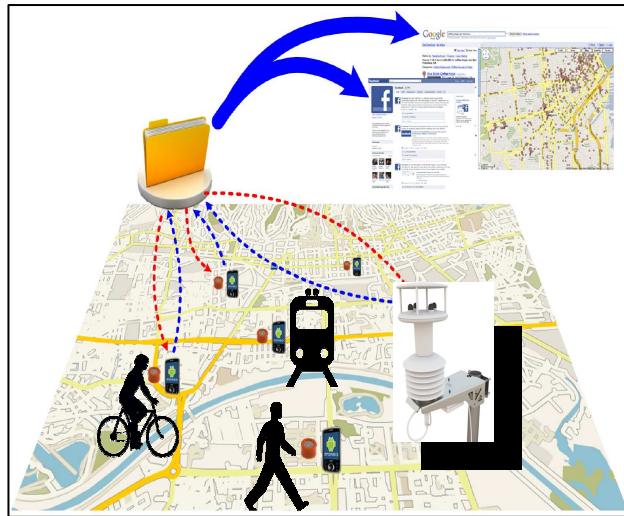


Vehicle formations

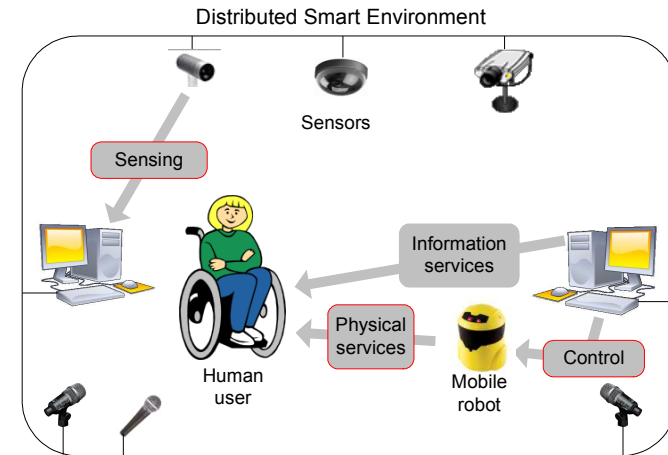




Cooperative Networked Embedded Systems

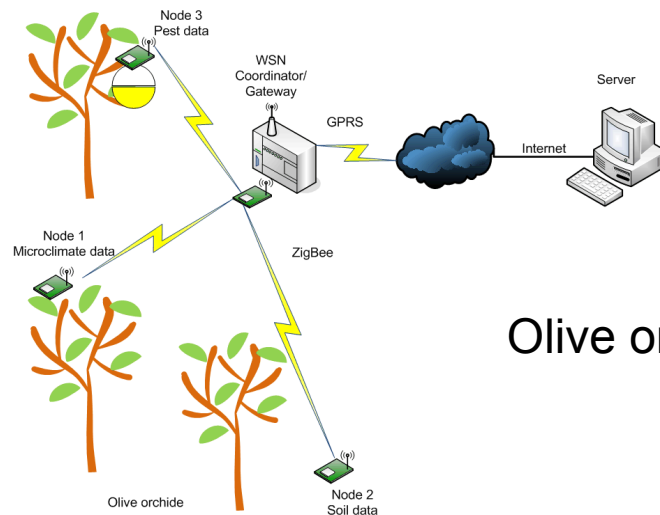


Smart City



Wired or wireless communication network

Ambient assisted living



Olive orchard



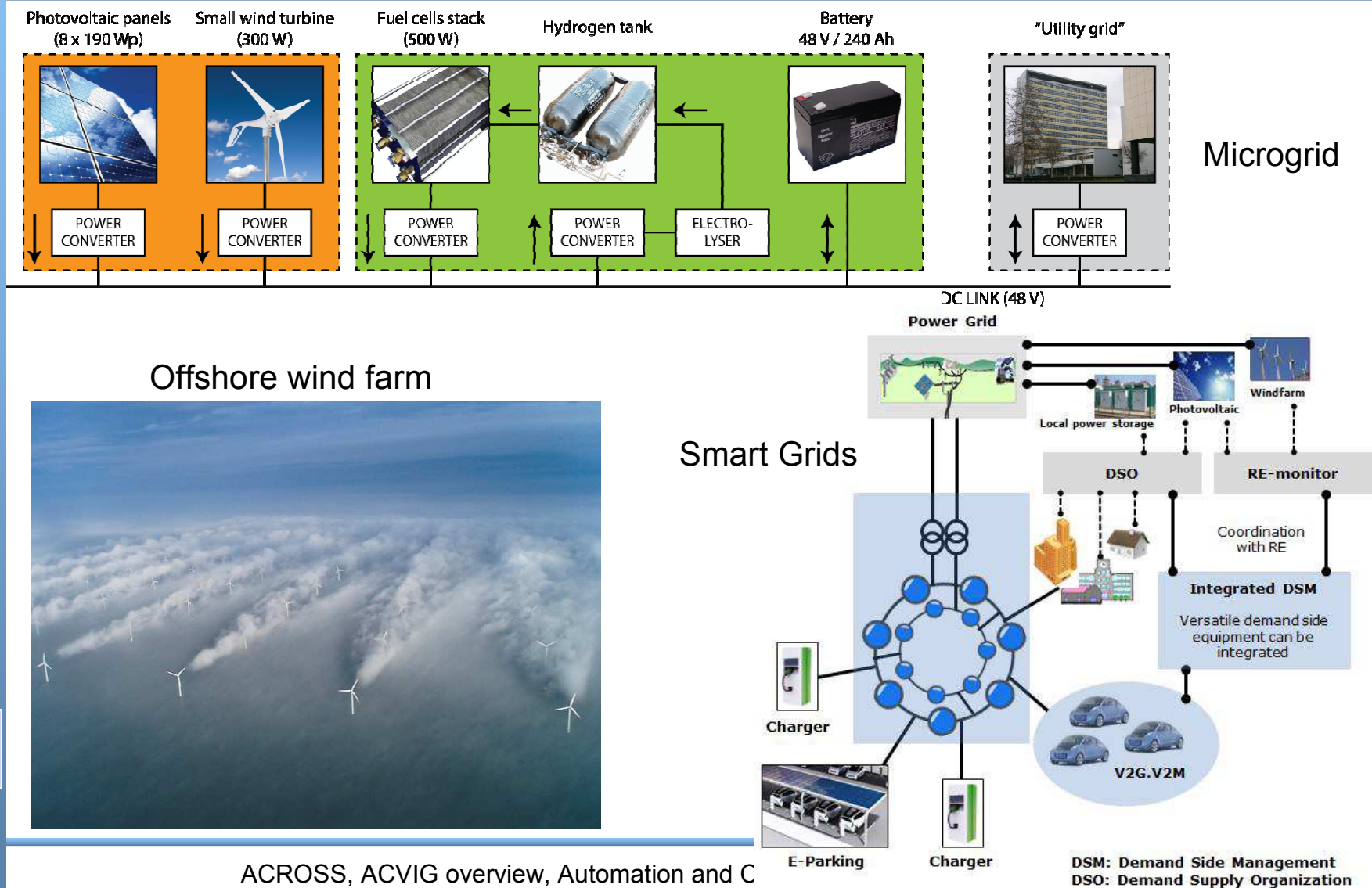


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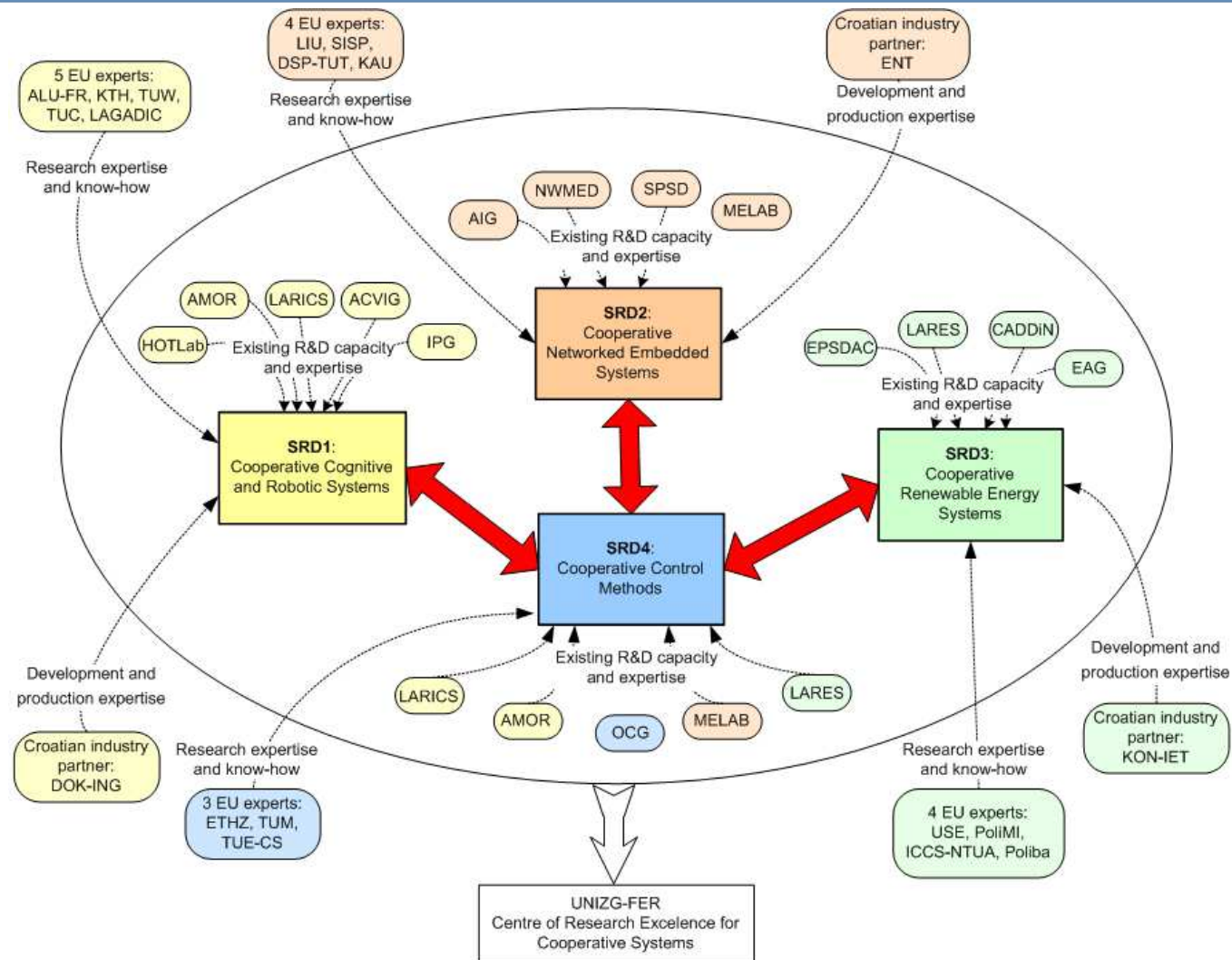


Cooperative Renewable Energy Systems





ACROSS Project Concept





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Applied Cognition and Vision Group (ACVIG)

Bojana Dalbelo Bašić (cognition)
Zoran Kalafatić and Siniša Šegvić (vision)

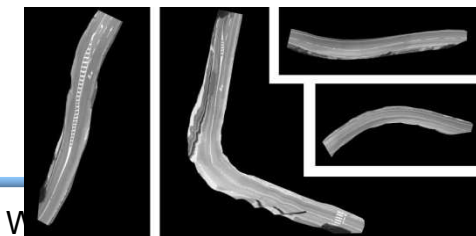
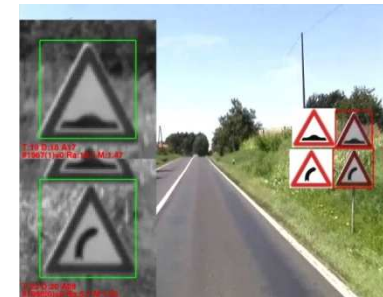
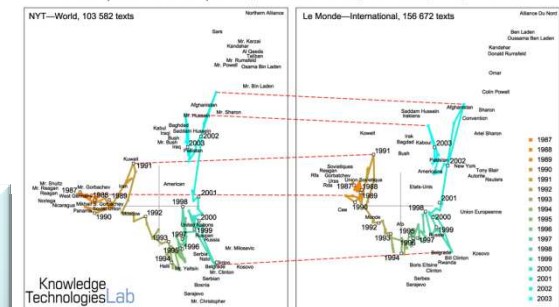
OBJECTIVES

- Computer vision applications for intelligent transportation systems
- Dynamic scene analysis
- Image categorization
- Information extraction, visualization, summarization and text analytics

TECHNOLOGIES

- Detection, tracking and recognition
- Geometric aspects of computer vision
- Supervised and unsupervised learning
- Natural language processing

An example of news comparison, NYT & Le Monde, 1987-2003, m=2, f=names





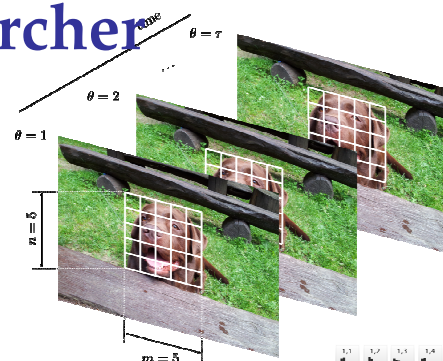
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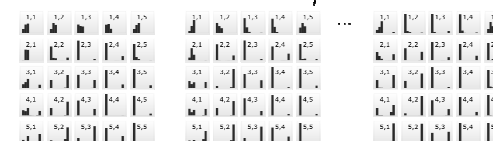
ACVIG: video analysis

Spatio-temporal appearance descriptors for video analysis and action recognition:

- idea: grid of histograms
- suitable for representing human actions
- suitable for rejecting false detections
- requirement: regions of interest
- Karla Brkić, postdoc researcher



The grid-of-histograms representation:



A grid histogram
 $u = 1, v = 5$
 $k = 8$ bins

Karla Brkic, Axel Pinz, Sinisa Segvic, Zoran Kalafatic. Histogram-Based Description of Local State-Time Appearance. SCIA, Ystad Saltsjöbad, Sweden May 2011: 206-217



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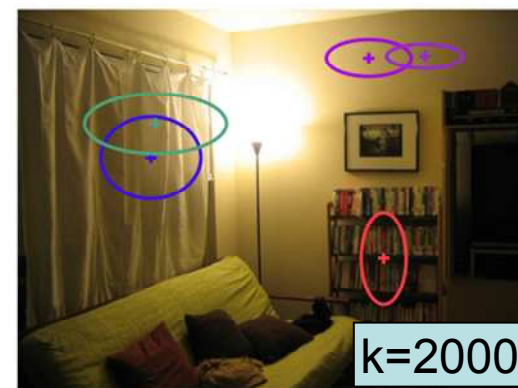
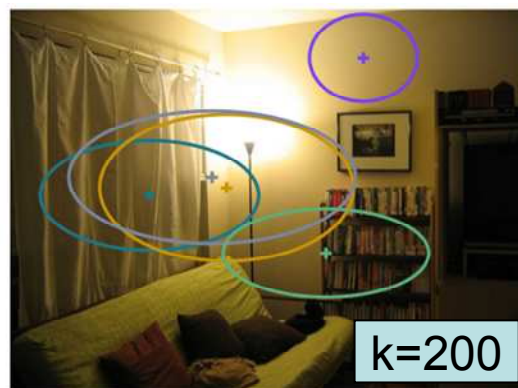
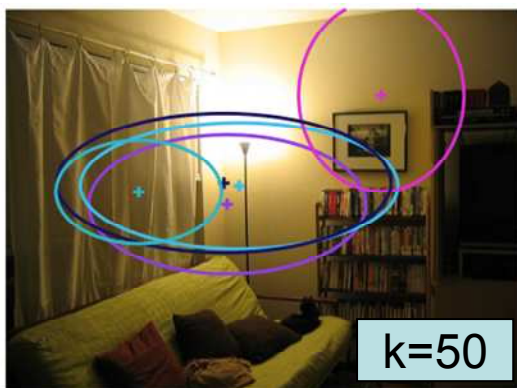
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ACVIG: image categorization

Modeling Spatial Layout with Fisher Vectors

- represent appearance and position by Fisher vectors
- future: fine grained classification
- Josip Krapac, postdoc researcher





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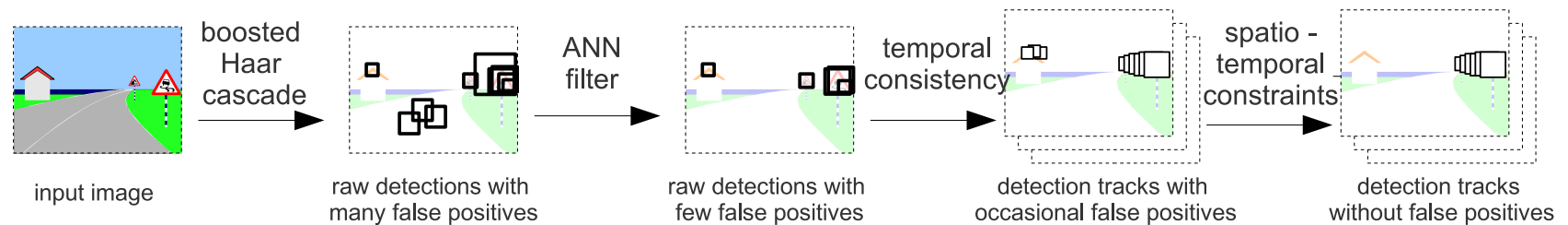
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ACVIG: object detection

A novel object detection pipeline

- **baseline detection by boosted Haar cascades**
 - skip grouping to preserve location accuracy
- **improve precision by an additional classifier**
 - the key idea: bootstrap training
- **improve location accuracy by favoring consistency**
 - track many location hypotheses, employ the best one
- **further improve precision by enforcing learned contextual constraints**



Sinisa Segvic, Karla Brkic, Zoran Kalafatic, Axel Pinz. Exploiting temporal and spatial constraints in traffic sign detection from a moving vehicle. Machine Vision and Applications. To appear.



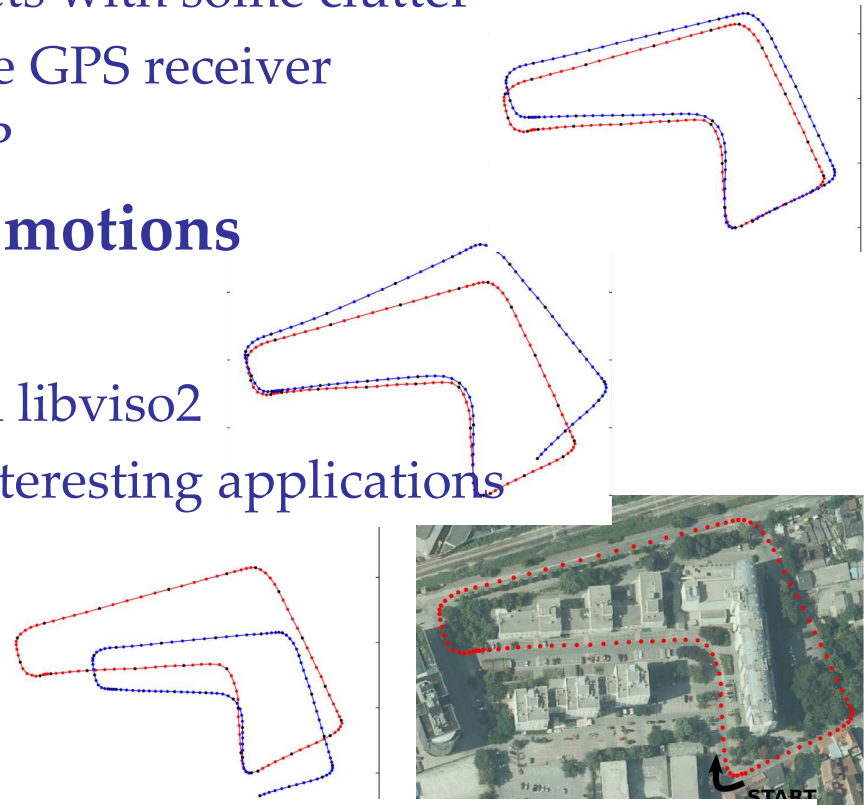
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ACVIG: structure and motion

Calibrated stereo from driver's perspective:

- **experimental evaluation on a novel dataset**
 - path of 700 m along city streets with some clutter
 - groundtruth: consumer grade GPS receiver
 - pick time to maximize HDOP
- **evaluate only incremental motions**
- **main results:**
 - proposed an improvement in libviso2
 - 12 cm baseline suitable for interesting applications
 - calibration target matters
- **Ivan Krešo, PhD student**



A Novel Georeferenced Dataset for Stereo Visual Odometry. Ivan Krešo, Siniša Šegvić and Marko Ševrović. Proceedings of the Croatian Computer Vision Workshop CCVW 2013.

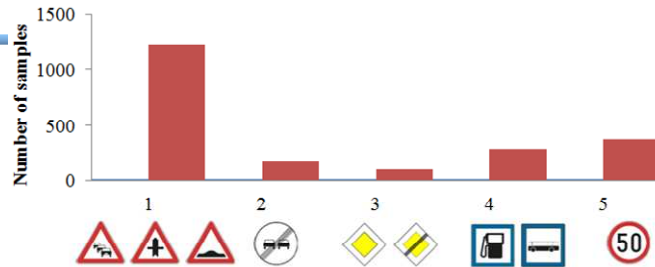


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ACVIG: other ongoing work



(a) highway



(b) road



(c) tunnel



(d) exit



(e) settlement



(f) overpass



(g) booth



(h) traffic

Multi-class object detection:

- problem: linear growth of complexity both in evaluation and training stages
- idea: feature sharing across classes
- approaches: multiplicative kernels, detection trees
- intermediate stage, one publication
- Valentina Zadrija, PhD student

Labeling traffic scenes by GIST:

- provide visual cues for fleet management
- low bandwidth scenario
- encouraging preliminary results
- collaboration with Mireo d.d
- Ivan Sikirić, PhD student

Multiclass Road Sign Detection Using Multiplicative Kernel. Valentina Zadrija and Siniša Šegvić. Proceedings of the Croatian Computer Vision Workshop CCVW 2013.

Classifying Traffic Scenes Using the GIST Image Descriptor. Ivan Sikirić, Karla Brkić and Siniša Šegvić. Proceedings of the Croatian Computer Vision Workshop CCVW 2013.



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Thank you for attention!