Laser-Based Feature Extraction and Pattern Recognition in Intersection Management Systems

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Pattern Recognition, 2014

Context

Master's Research Project: Multisensor Architecture for a Vehicular Intersection Management System

Transportation Systems

Issues in traditional transportation systems

- Congestion
- Traffic rules violation
- Vehicle interaction

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Intersections are critical places in transportation systems

Intelligent Transportation Systems

Objectives of ITS

- Increase safety
- Increase efficiency
- Reduce costs

Intersection Management Systems

Tasks

- Traffic Monitoring
- Traffic Management
- Warning Advertisement

Intersection Scenario

Pedestrians, Vehicles (Cars, Two-wheeled vehicles, Big vehicles)

Recognition, Classification, Tracking

Incident detection, Intersection Management

Objectives

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- Review of the state-of-the-art of sensor fusion in IMS
- Techniques review and architecture design
- Laser and video sensor fusion implementation
- Incident detection and warnings advertisement
- Testing and Comparison

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For the course project:

- In blue are the tasks proposed for this course project.
- In green are the tasks proposed as plus if time allows it.

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Objectives

Objective 1. Review of the state-of-the-art of Sensor Fusion in IMS

- Intelligent Transportation Systems (ITS)
- Intersection Management Systems (IMS)
- Multisensor Data Fusion (MDF)
- Laser-Video Data Fusion
- IMS + LV-DF

Objectives

Objective 1. Review of the state-of-the-art of Sensor Fusion in IMS

- Intelligent Transportation Systems (ITS)
- Intersection Management Systems (IMS)
- *Multisensor Data Fusion (MDF)*
- *Laser-Video Data Fusion*
- *IMS + LV-DF*

Objectives

Objective 2. Techniques review and architecture design

- Feature Extraction (Laser/Video)
- Pattern Recognition (Laser/Video)
- Classification (Laser/Video)
- Decision (Laser/Video)
- Low-Level, Mid-Level and High-Level Fusion

Objectives

Objective 2. Techniques review and architecture design

Feature Extraction (Laser/Video)

Pattern Recognition (Laser/Video)

Classification (Laser/Video)

Decision (Laser/Video)

Low-Level, Mid-Level and High-Level Fusion

Objectives

Objective 3. Laser and video sensor fusion implementation

- Implement choosen techniques for laser and video data
- Integrate developed modules to the designed architecture for sensor fusion

Objectives

Objective 3. Laser and video sensor fusion implementation

Implement choosen techniques for laser and video data

Integrate developed modules to the designed architecture for sensor fusion

Objective 4. Incident detection and warnings advertisement

Objective 5. *Testing and Comparison*

Objective 4 is out of the scope of this class.

Main Objective

To develop a feature extraction and pattern recognition laser-based module for an intersection management system

Sub-objectives

Review of laser-based feature extraction and pattern recognition in ITS and IMS

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Review of laser-based feature extraction and pattern recognition in ITS and IMS

Evaluate pros and cons of the reviewed methods

Implement at least one method

Evaluate implemented module and compare it with similar developments

Conditions

The information source will be a dataset.

Research Groups

PKU Omni Smart Sensing (POSS) Research group at Peking University (POSS-i project)

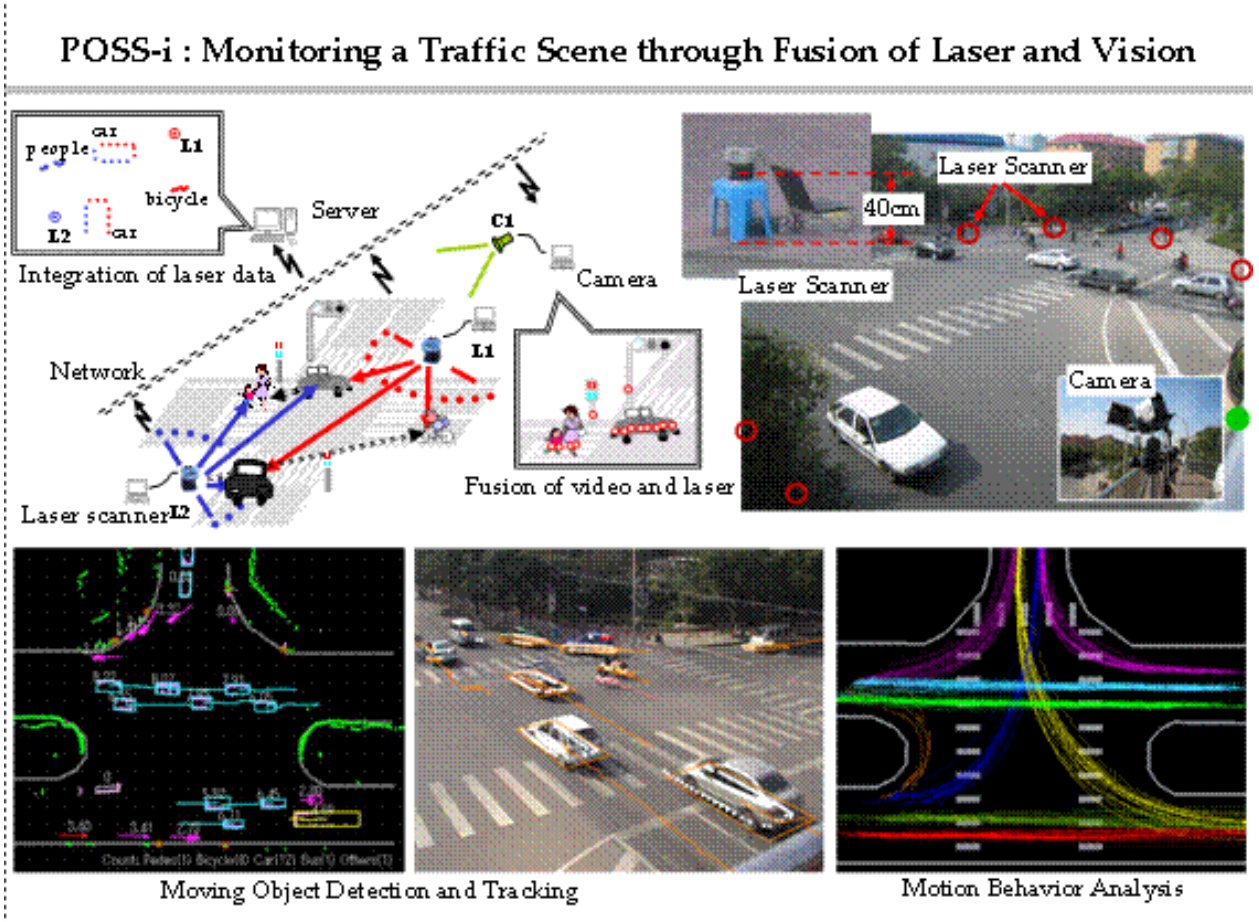
Institute of Measurement, Control and Microtechnology at Ulm University (Ko-PER program)

PKU Omni Smart Sensing (POSS)

POSS is leaded by Prof. Huijing Zhao, Ph.D.

Focus on perception technologies using an intelligent vehicle, a network sensing system or a collaboration of them

POSS-i



POSS-i project. [Zhao09][Zhao12][Song13b]

Ko-PER

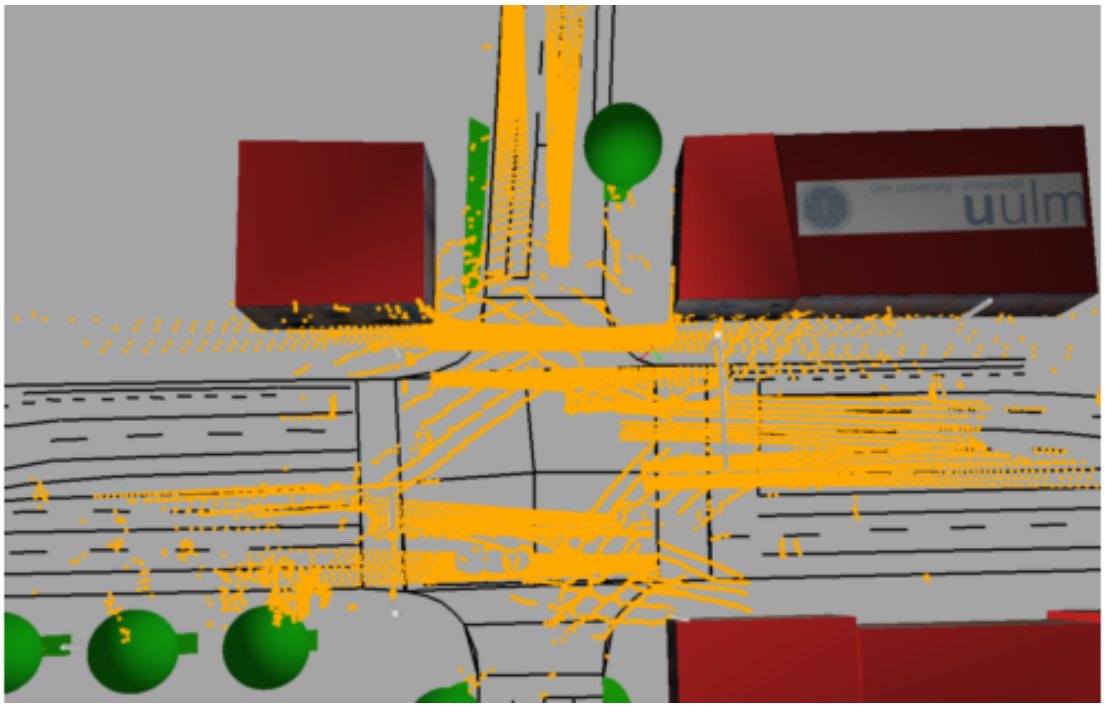
Ko-PER from Cooperative Perception

Included in Forschungsinitiative Ko-FAS from Bundesministerium für wirtschaft und Technologie (Germany)

Cooperative and collaborative sensors system for perception and preventive road safety.

Daniel Meissen from Ulm University as leader researcher.

Projects



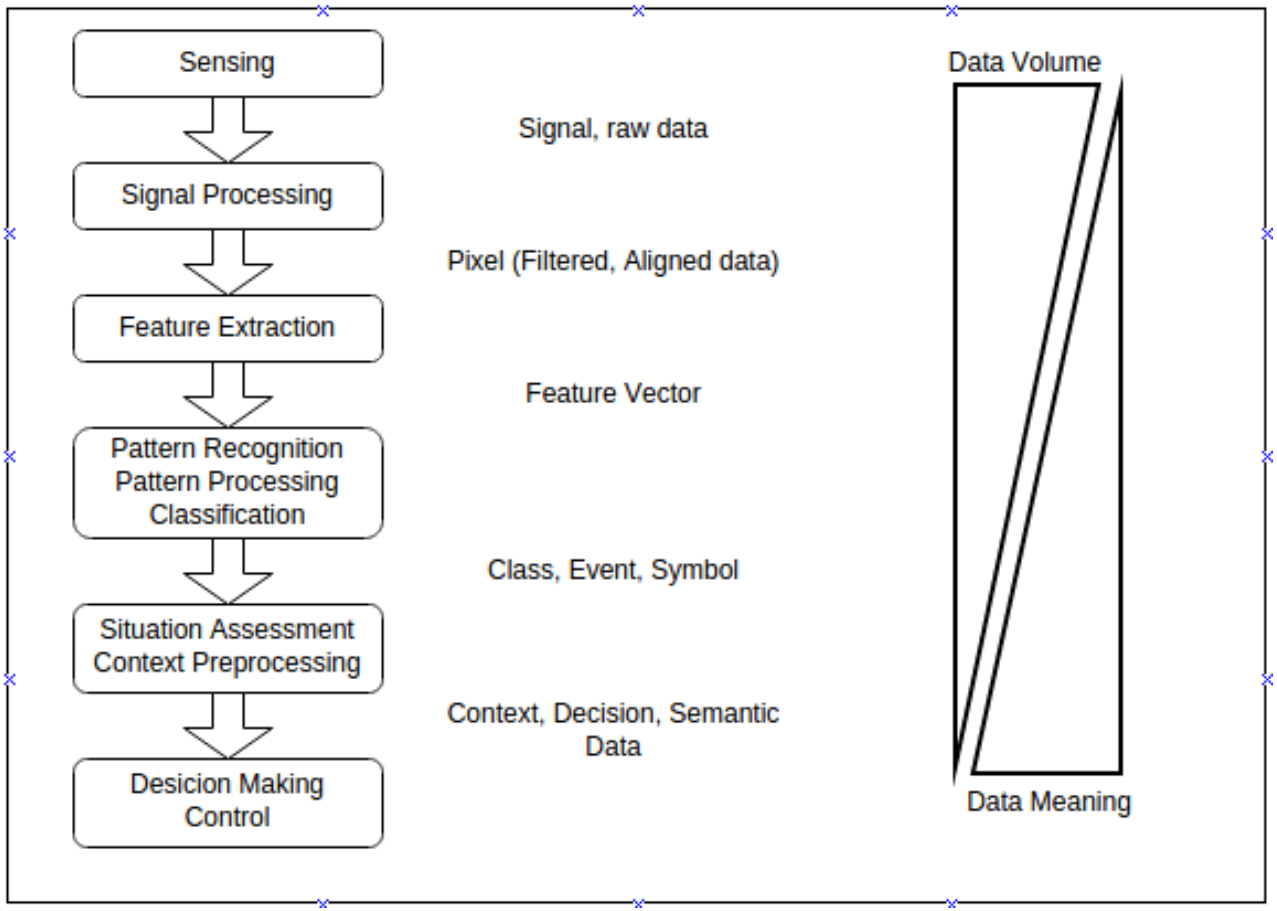
3D-recreated intersection scene with laser beams depicted [Meissner12, 13a, 13b, 13c, 14][Striegel13]

Applications, Methods and Techniques

Project	POSSi	Ko-PER
Applications	Recognition, Classification and Tracking of Vehicles and Pedestrians	
Methods and Techniques	- Clustering - Markov Chains - Kalman Filtering - AdaBoost	- DBSCAN - Multi-object Bayes Filter - Sequential Monte Carlo Methods - Dempster-Shafer Theory - Multiple-Model Probability Hypothesis Density Filter (in Gaussian Mixture representation)

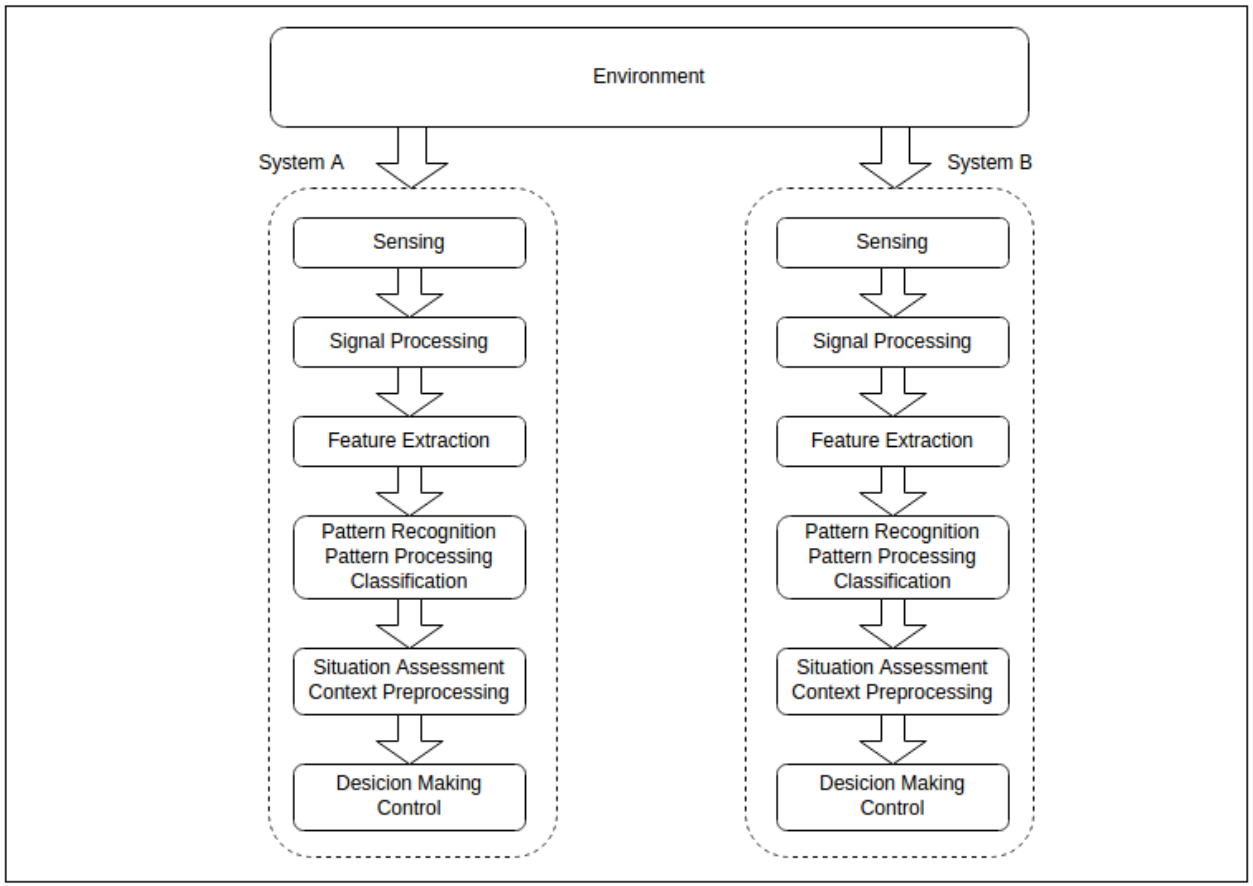
POSSi and PKU projects comparison

Typical System for one source of data



Typical Application or System Data Flow

Multisensor Data System



Typical Application or System Data Flow

Block Diagrams

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