technische universität dortmund

UNIVERSITÄT DUISBURG ESSEN

SFB 876 Providing Information by Resource-Constrained Data Analysis

Project B4

Analysis and Communication for Dynamic Traffic Prognosis

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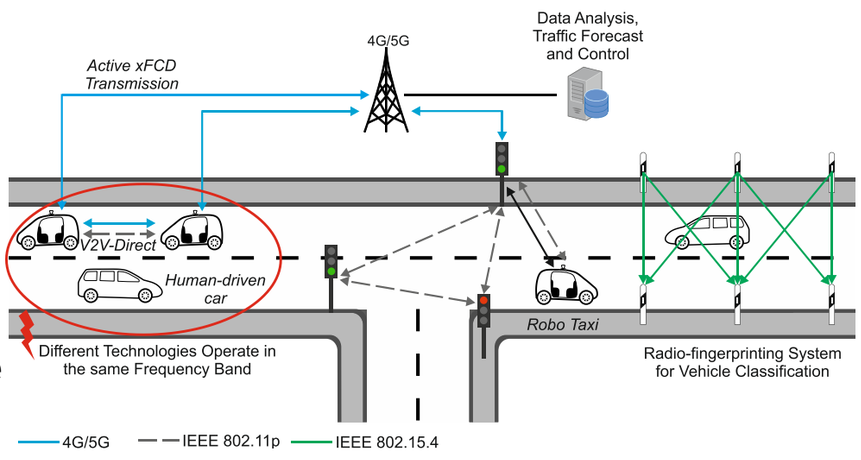
Problem and Methodology for Phase 3

Challenge: Step-wise Transition Towards Autonomous Traffic

- Coexistence of automated vehicles and human drivers
- Coordination capabilities depend on availability of communication systems
- Automated systems react passively on human malpractice
- Increased amount of empty runnings due to freight and on demand traffic



Evolution of the Research Goals

- Analysis of hybrid traffic on highways as well as in inner cities
- From channel-aware LTE data transfer to context-predictive V2X communication
- Poisson Dependency Networks and Sum-Product Networks
- Knowledge about physical traffic models is integrated into machine learning models

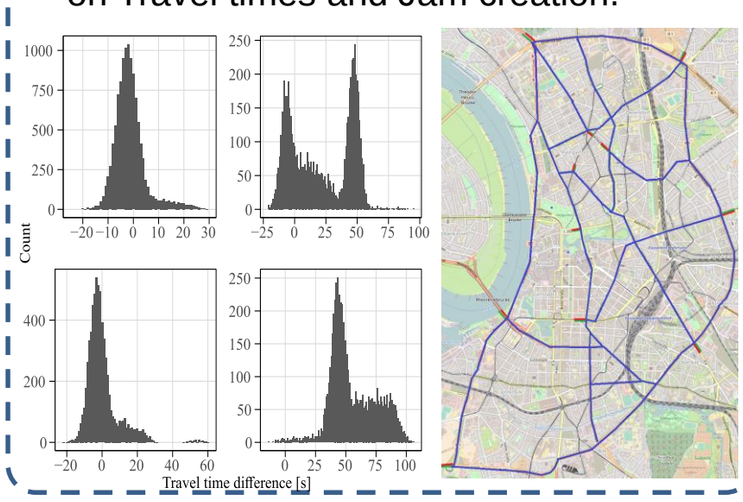
Analyzing Hybrid Traffic

Microscopic Traffic Models

- Derivation of a closed microscopic model for hybrid vehicular traffic (cellular automata)
- Interactions of automated vehicle with human driven once will be identified and analysed

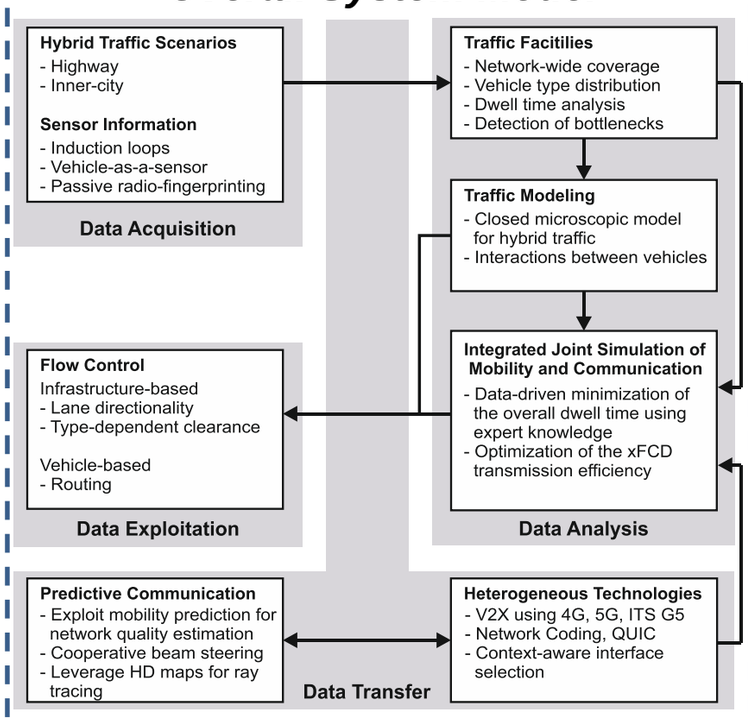
Traffic Forecast and Jam Prognosis

- Assumptions of traffic flow and its impact on Travel times and Jam creation.



Methodological Approach

Overall System Model

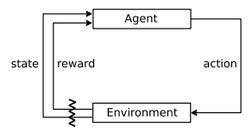


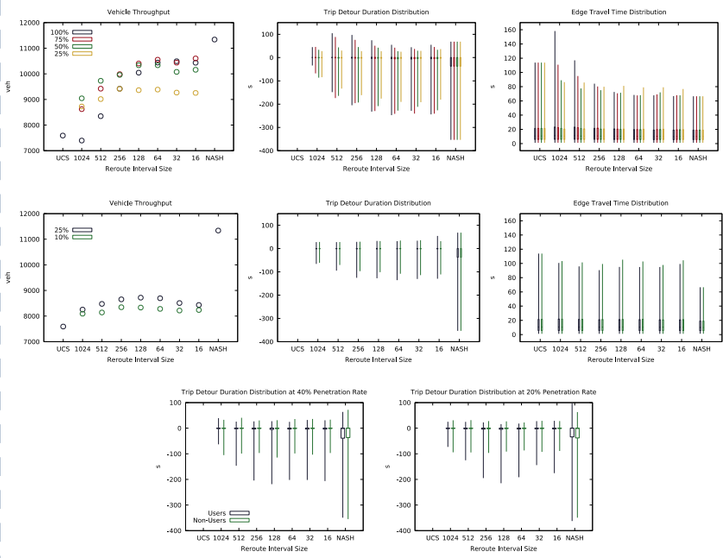
- Validation based on simulation and field evaluations

Novel Data Analysis Methods

Routing with Reinforcement Learning

- Vehicles = agents
- Turning decisions = actions



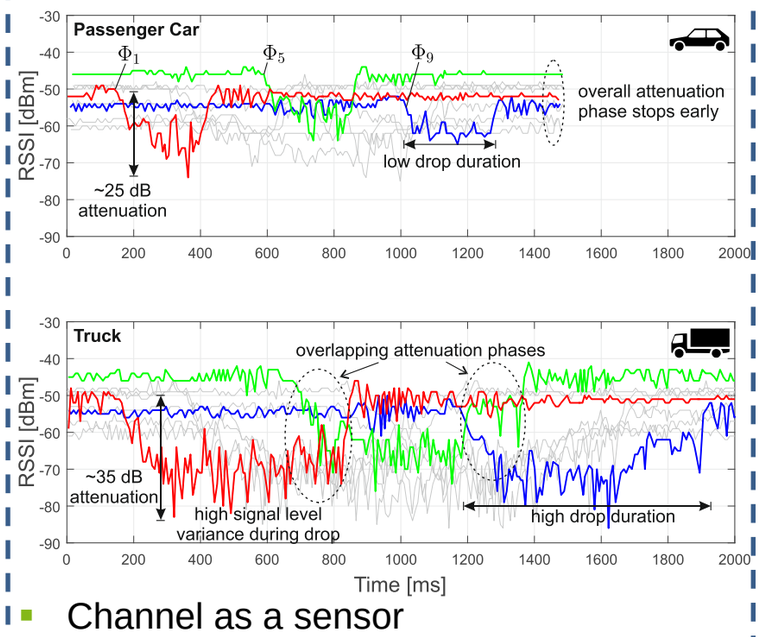


[Liebig, Sotzny, COSIT, 2017, **Best Paper Award**]

Preparatory Work

Data Acquisition

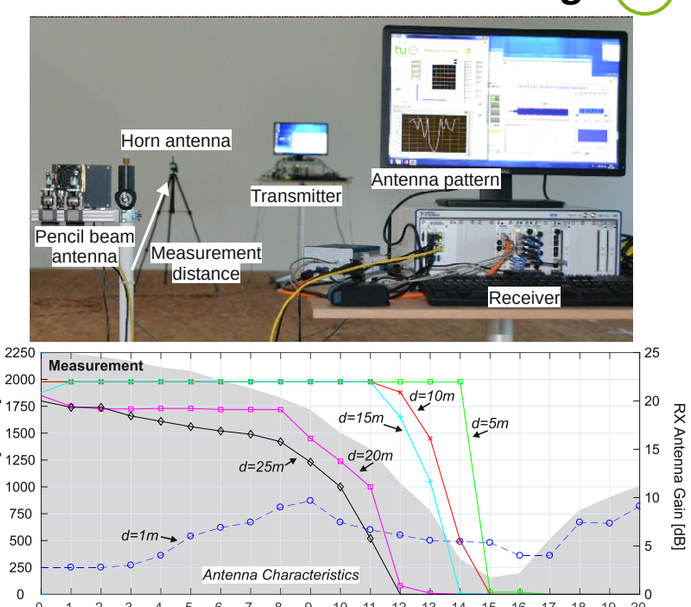
Radio-fingerprinting-based Vehicle Classification A1



- Channel as a sensor
- Determination of the traffic situation and vehicle type information
- Resource-efficient implementation using L1/L2-SVM [Sliwa, Piatkowski, …, Wietfeld, ITSC, 2018]

Exploiting 5G Technology

Predictive Beam Steering A4

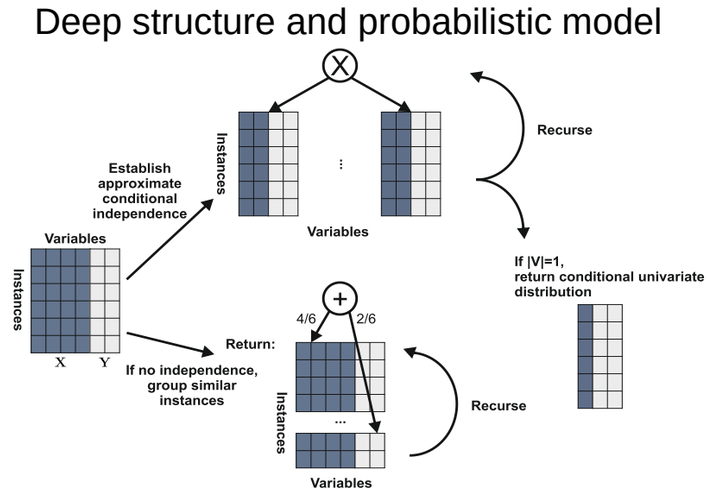


- Precise alignment required for reliable and efficient data transfer [Sliwa, Monhof, …, Wietfeld, Submitted to ACM Conference]
- Approach: Cooperative beam steering exploiting mobility prediction

Intelligent Traffic Control

Conditional Sum-Product Networks

- Deep structure and probabilistic model



Routing with Reinforcement Learning and Breakdown Minimization Principle (BMP)

- Incorporate BMP to prevent critical traffic flows
- Adds constraints to reinforcement learner

Artificial Intelligence Group

Physik von Transport und Verkehr

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