Online Fusion of Vehicle Sensor and Safety Server Backend Map Data

BACKGROUND AND MOTIVATION
Automated driving functions need a consistent representation of the road and its lanes with associated traffic rule-related lane attributes for proper behavior planning and decision making, a so-called road model.

The road model can either be derived from sensor data or from digital map data provided by the safety server backend.
Online road model fusion to increase robustness and quality of the road/lane representation for the driving functions.
Road model fusion involves fusion of lane geometry, topology, and attributes.

FUSION CHALLENGES
Adequate integration of traffic regulation, situation, sensor, and digital map knowledge.
Proper dealings with incomplete, uncertain, and inconsistent information sources.

MAIN CONTRIBUTIONS
General high-level road model fusion framework to infer lane-specific traffic rules by combining.

i) regulatory traffic elements:

ii) lane geometry:

iii) digital map info:

Full considerations of spatial, existence, and attribute uncertainties without intermediate hard decisions.
Additional incorporation of uncertain situation knowledge within a Dempster-Shafer-based attribute fusion.

FUSION FRAMEWORK OVERVIEW
Sensor-based information fusion to generate a sensor-based road model with traffic rule-related attributes.
Map-based information fusion to include digital map attributes.

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KEY METHODS
Monte Carlo simulations for the estimation of position relations between regulatory traffic elements and lanes.
Bayesian networks for logical lane assignment of traffic elements under incorporation of traffic regulation knowledge and position relations.
Dempster-Shafer theory for i) fusing multiple simultaneously sensor-detected traffic signs and ii) traffic situation-dependent fusion of digital map attributes with sensor-inferred attributes.

EXEMPLARY FUSION RESULT
Situation-dependent speed limit fusion and inference within a construction site.