HoliDes
HOLISTIC HUMAN FACTORS AND SYSTEM DESIGN
OF ADAPTIVE COOPERATIVE HUMAN-MACHINE SYSTEMS

Driver Intention Recognition

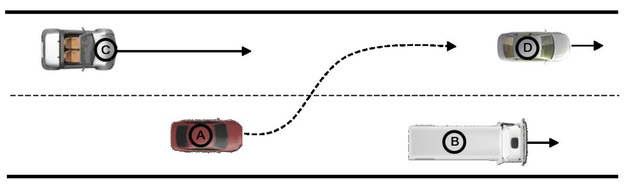
ARTEMIS

Motivation

Adaptive and anticipatory onboard driving systems require the integration of internal models of the human driver in order to:

- Allow the automated reconfiguration and adaptation of assistance functionalities and/or the human machine interfaces (HMI) based on the capabilities, needs, and intentions of the human driver,
- Allow the early detection of non-normative driving behavior for recognizing and preventing safety and performance critical situations and events,
- While at the same time allow the reduction, delay, or suppression of assistance functionalities in non-critical situations, preventing unreasonable interventions and warnings that lead to problems of acceptance.

The AdCoS "Adapted Assistance" focusses on the advanced cooperation between the human driver and machine-agents in overtaking scenarios by adapting the system functionalities and HMI to the driver's lane-change intentions.



As such, the AdCoS requires the integration of MTTs for context assessment that are able to provide context-dependent estimations about the current lane-change intentions of the human driver. Within the AdCoS "Adapted Assistance", this ability is provided by the **Driver Intention Recognition** (DIR) module.

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Methods, Techniques, Tools

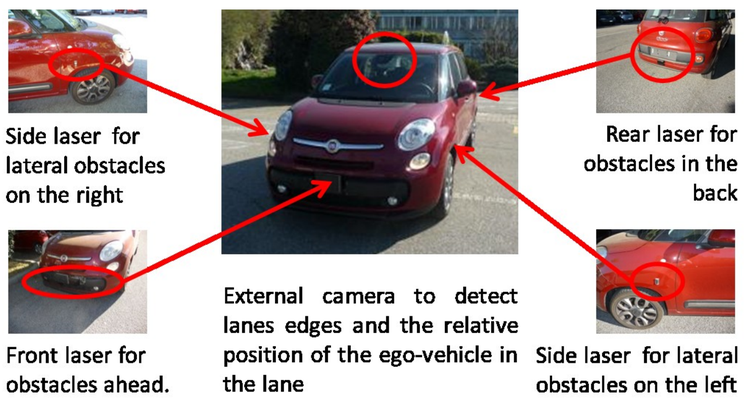
This is a …	[X] Method	[X] Technique	[X] Tool
Method	Machine-Learning		
Technique	Probabilistic Operator Modelling		
Tool	Driver Intention Recognition (DIR) module		

Overview of the Driver Intention Recogntion (DIR) module

The DIR module is a non-lifecycle MTT for context assessment that provides the AdCoS "Adapted Assistance" with the hidden intentions of the driver in two-lane highway overtaking scenarios. It is implemented as a set of RTMaps components that can be used for AdCoS modelling and online-utilization. Using RTMaps, the DIR module has been successfully integrated into the AdCoS "Adapted Assistance" and the CRF demonstrator vehicle.

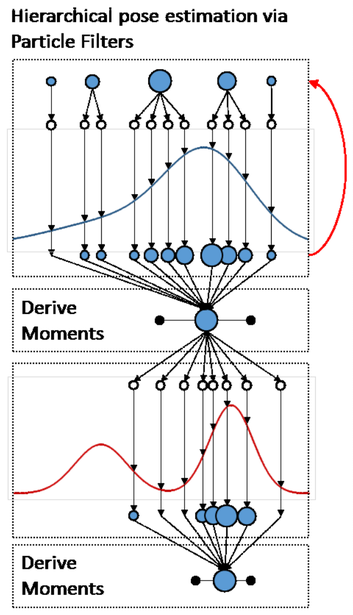
Input ①

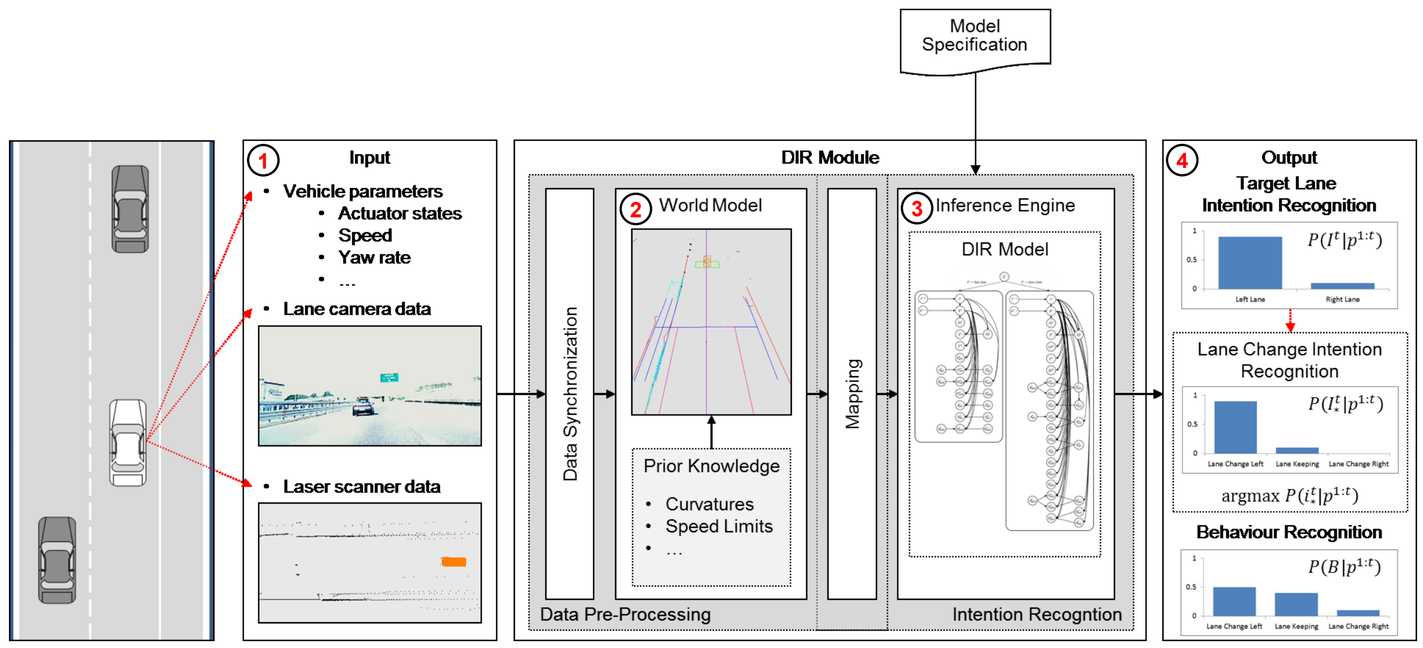
The DIR module receives input from the vehicle's sensors, providing vehicle parameters, course and pose information, and information about obstacles and vehicles in the vicinity.



World Model ②

The world model uses particle filters to augment the available sensor information with improved estimates of the future course of the road and the vehicle's pose. The information is then used to match vehicles in the vicinity to predefined roles (e.g. the lead-vehicle, or the vehicle behind).

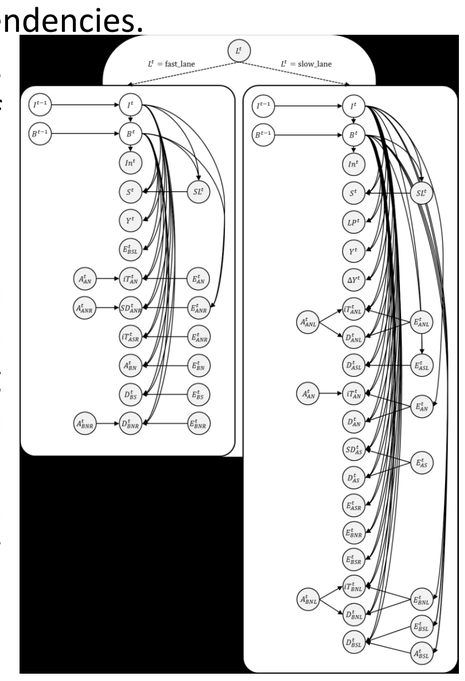




Inference Engine and DIR Model ③

The core of the DIR module is an inference engine that perform probabilistic inferences in a probabilistic model for intention recognition: the DIR model. The DIR model is conceptualized as a Dynamic Bayesian Network with context-dependent independencies.

The parameters and structure of the DIR model were derived via machine-learning methods from data obtained in real-world driving studies on Italian highways conducted with the CRF demonstrator vehicle.

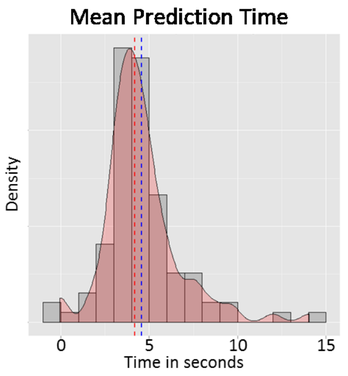


Output and Results ④

During runtime, the DIR module provides context-dependent estimates of the driver's current target lane resp. lane change intentions of the driver and the currently shown maneuver (lane-keeping or lane-changing).

Confusion Matrix

		Predicted Lane Change Intention: Yes	Predicted Lane Change Intention: No
Accuracy = 0.908 F-Score = 0.721 PRE = 0.717 REC,TPR = 0.725 FPR = 0.056			
"True" Lane Change intention	Yes	True Positives: 8337	False Negatives: 3157
	No	False Positives: 3298	True Negatives: 55161



For validation purposes, the DIR model was used on unseen testdata. The DIR module achieves an accuracy of 0.908 and a mean predictive time in respect to the lane-crossing of approx. 4.19 - 4.57 seconds, surpassing the current state of the art of approx. three seconds.

Consortium

Acknowledgments

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