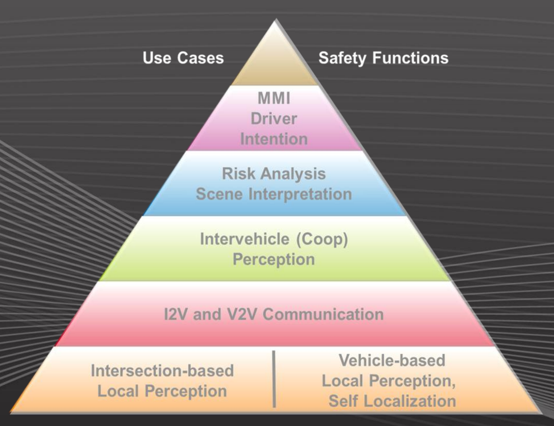


Project Ko-PER

Driver Intent Inference Based on Parametric Models.

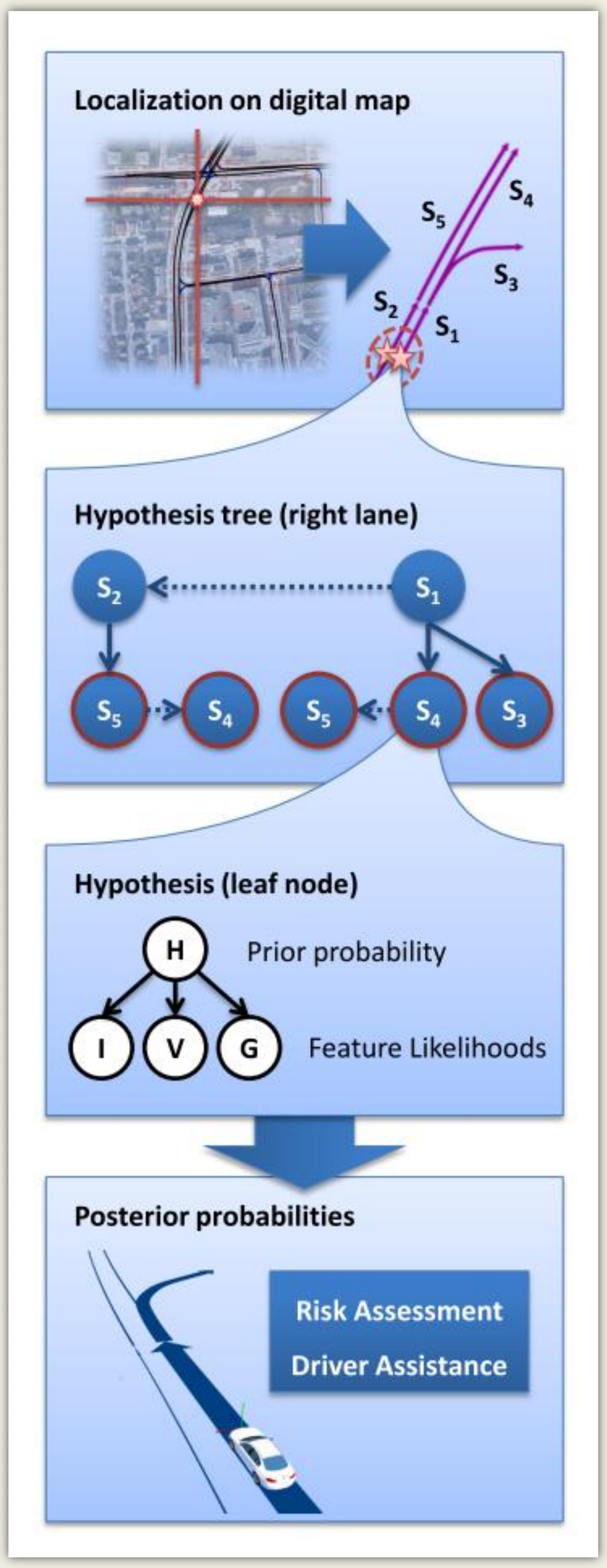
FORSCHUNGSINITIATIVE KO-FAS

Why Parametric Models?

In order to decrease the risk of accidents and provide a comfortable driving experience at complex inner-city intersections, the car must be able to predict the drivers intended path of travel. Due to the interaction with other traffic participants as well as a high variety of intersection geometries, this cannot be achieved by comparing the observed driver behavior with a mere set of typical patterns. Instead, the underlying rules or driver models need to be taken into account. Using parametric models, existing expert knowledge can be easily included in the model building process. Parameterization has been carried out on the basis of extensive user studies.

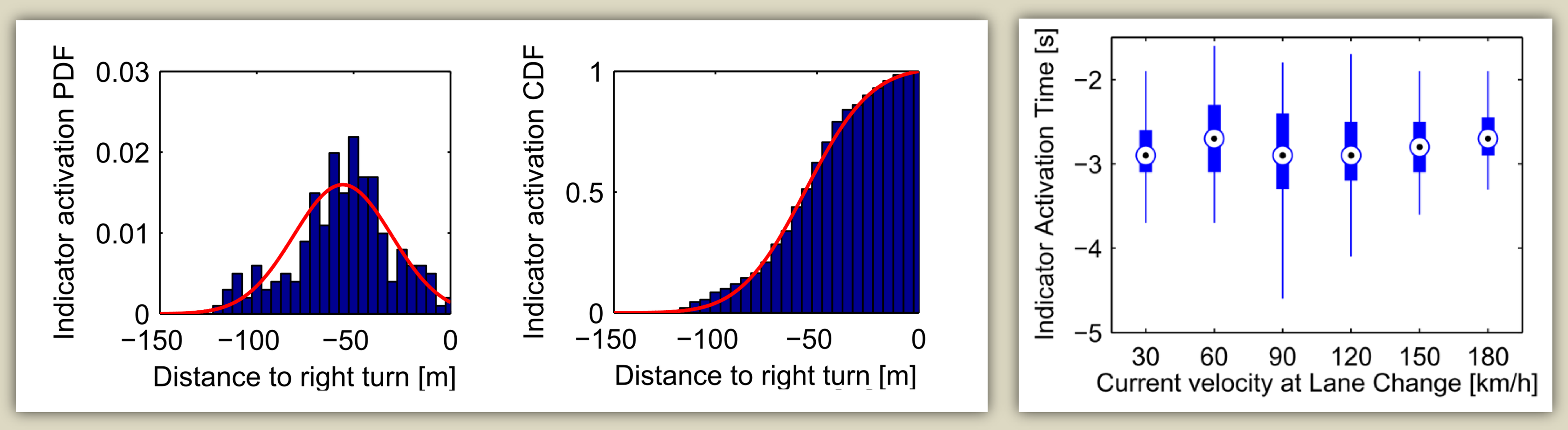
General Architecture – a Brief Outline of the Approach.

For driver intent inference, we rely on lane level self localization on a high-precision digital map that represents possible driving paths as a sequence of distinct lane segments. Assuming a maximum of one lane change maneuver within the length of each lane segment, a directed acyclic graph is obtained. Each leaf node of this so-called hypothesis tree refers to a unique path with a given prior probability. The corresponding posterior is determined by evaluating the likelihood of one or several of the following features given that the driver was to follow that particular path. The posterior path probabilities are then used to determine the risk of potential conflicts.



Indicator Feature

Even though activating the indicator constitutes a strong lead that the driver's next action will be a lane change or turn maneuver, it is possible that the indicator was set unintentionally or due to a later maneuver after first going straight. Taking into account the exact time of indicator activation helps to distinguish both cases from imminent turn or lane change maneuvers.



Velocity Feature

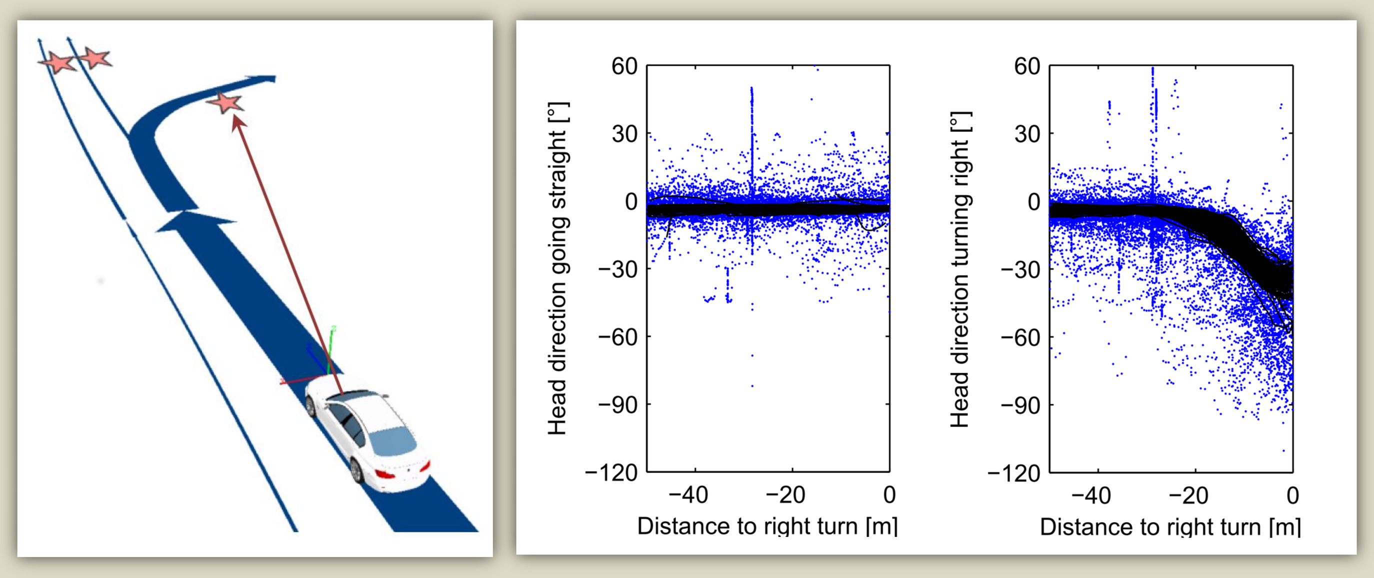
In order to keep the lateral acceleration within comfortable limits, drivers usually need to slow down before doing a left or right turn. In cases of preceding vehicles or unusual intersection geometries, however, the distinction between going straight and turn maneuvers is not that easy to make. The approach described in [1] takes both situations into account.

Intelligent Driver Model.

$$\dot{v} = a\left[1 - \left(\frac{v}{u}\right)^{\delta} - \left(\frac{d^*(v,\Delta v)}{d}\right)^2\right],$$

$$d^*(v,\Delta v) = d_0 + T\,v + \frac{v\,\Delta v}{2\sqrt{a\,b}}.$$

Gaze Direction Feature



Naturally, drivers tend to turn their heads in the direction of intended travel. By observing the driver's head heading angle, we evaluate each hypothesis by how well the driver's head direction matches that of the expected gaze point along the corresponding path.

References

[1] M. Liebner, F. Klanner, M. Baumann, C. Ruhhammer, C. Stiller, "Velocity-based Driver Intent Inference at Urban Intersections in the Presence of Preceding Vehicles", IEEE Intelligent Transportation Systems Magazine, Vol. 5-2, pp. 10-21, 2013.

[2] M. Liebner, F. Klanner, C. Stiller, "Der Fahrer im Mittelpunkt – Eye-Tracking als Schlüssel zum mitdenkenden Fahrzeug?", Tagungsband des 8. Workshop Fahrerassistenzsysteme, Walting, Sept. 2012.

[3] M. Liebner, C. Ruhhammer, F. Klanner, C.Stiller, "Generic Driver Intent Inference based on Parametric Models", IEEE Intelligent Transportation Systems Conference, The Hague, The Netherlands, Oct. 2013.

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