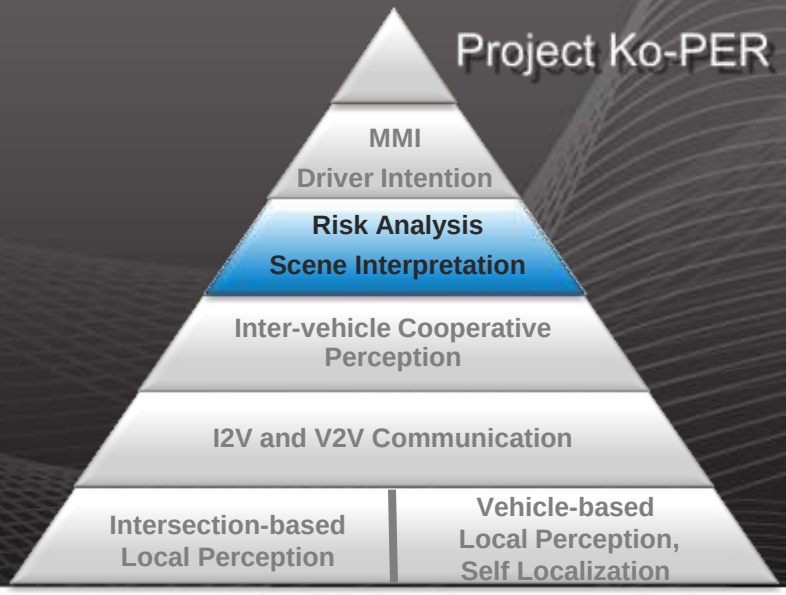
FORSCHUNGSINITIATIVE
K O - F A S



Context-Dependent Scene Interpretation and Collision Risk Prediction

Kontextabhängige Situation Interpretation und Bewertung von Kollisionsrisiko

Dr. Galia Weidl
Daimler AG, Situation Analysis

Gefördert durch:
Bundesministerium für Wirtschaft und Technologie
aufgrund eines Beschlusses des Deutschen Bundestages

Objectives for Context-Dependent Situation Interpretation

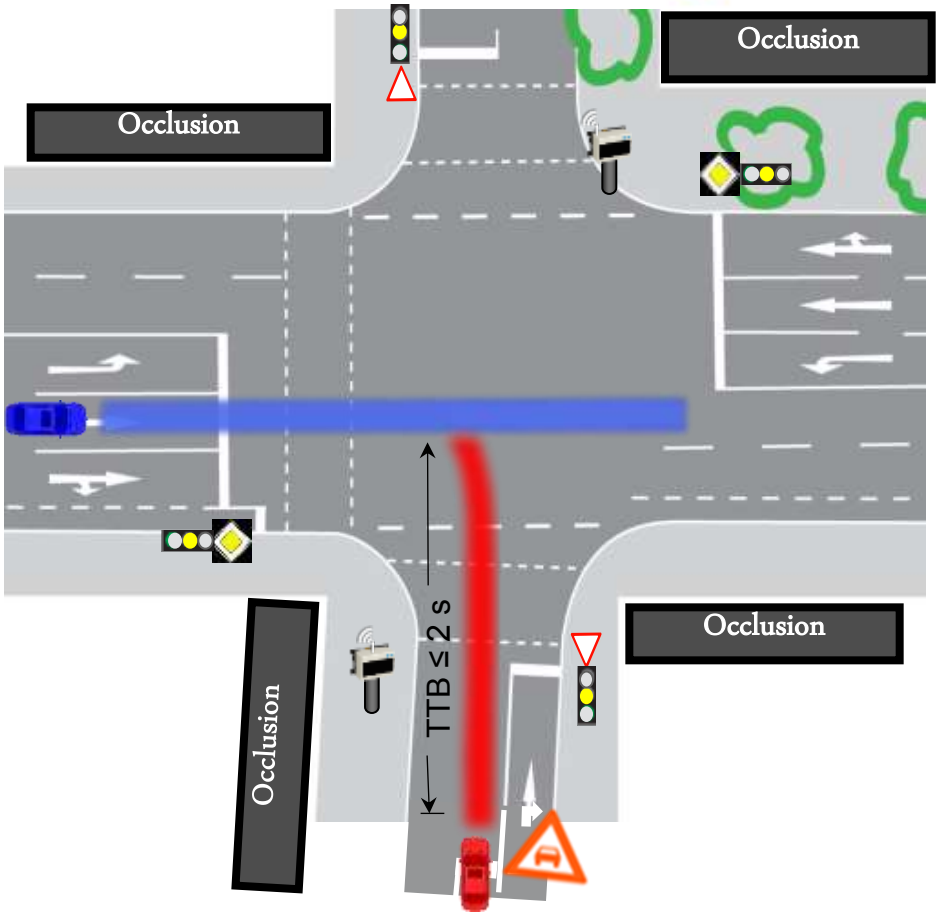
FORSCHUNGSINITIATIVE
K O - F A S

Objectives

- Recognition of Driver Intention
  - stop, turn L/R, straight
- Risk Assessment

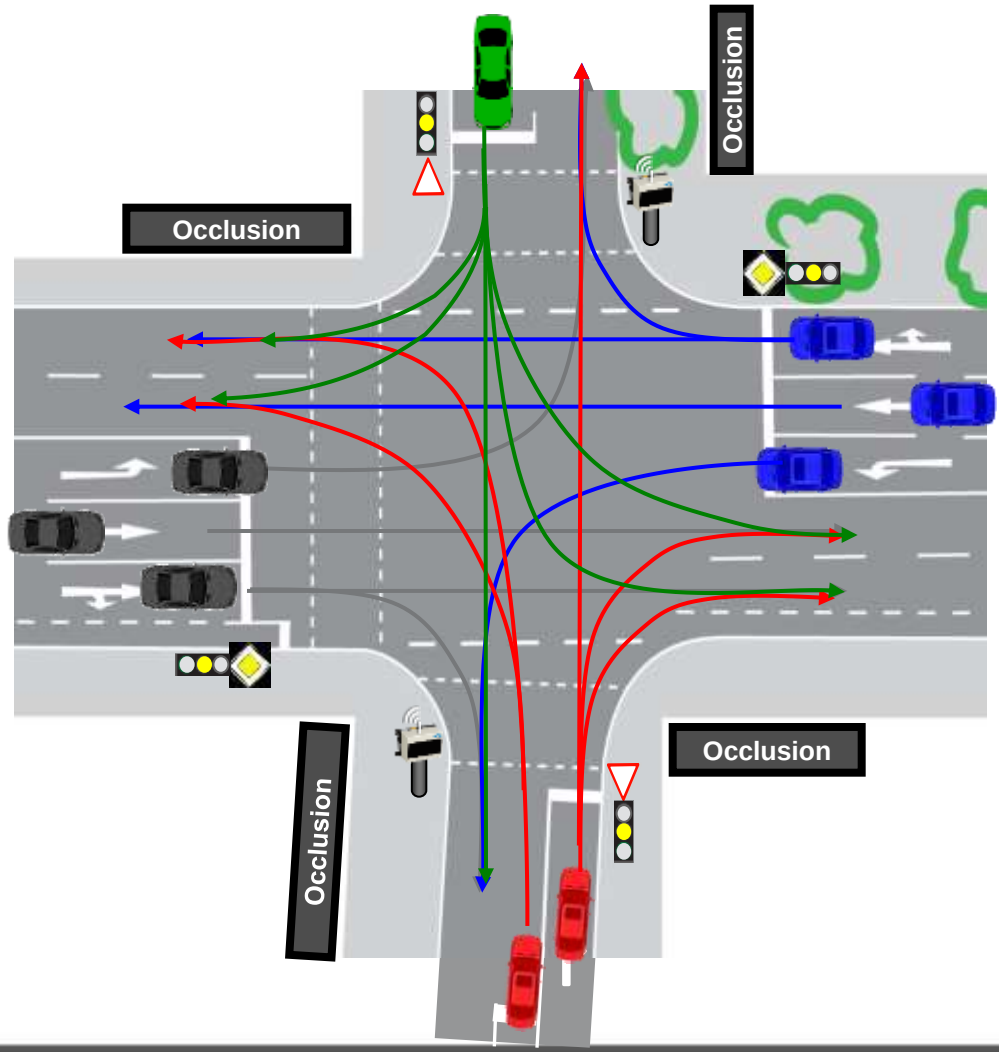
Appropriate Strategy

- Warn the driver 2 seconds* before the last instant to avoid the collision by braking



* HMI-Efficency & Acceptability: Frederik Naujoks et al., IZVW – Uni Würzburg

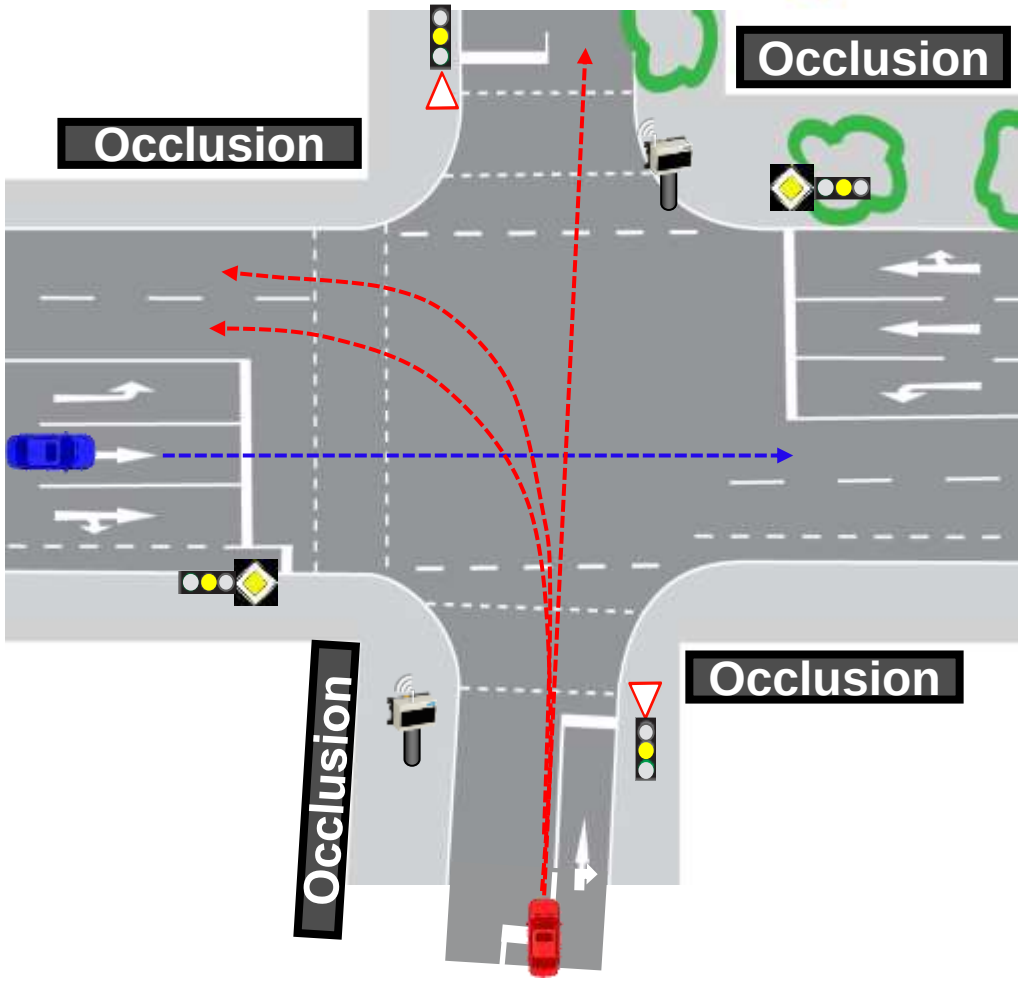
Challenges for Context-Dependent Situation Interpretation



- Many road users on the intersection → Combinatorial and interpretation issues
- Context dependency
  - Localization, Intention prediction, Traffic rules
  - Occlusions → Communication to complete the field of view
- Handling of data
  - Heterogeneous input
    → Measured, computed, communicated
  - Uncertainties in data

Intention Recognition and derived Situation Features

- Assumptions:
  - Vehicles behavior is conform with traffic rules
- Digital Map*:
  - allowed maneuvers, priority rules
- Forward predicted paths**
- Extraction of Situation Features

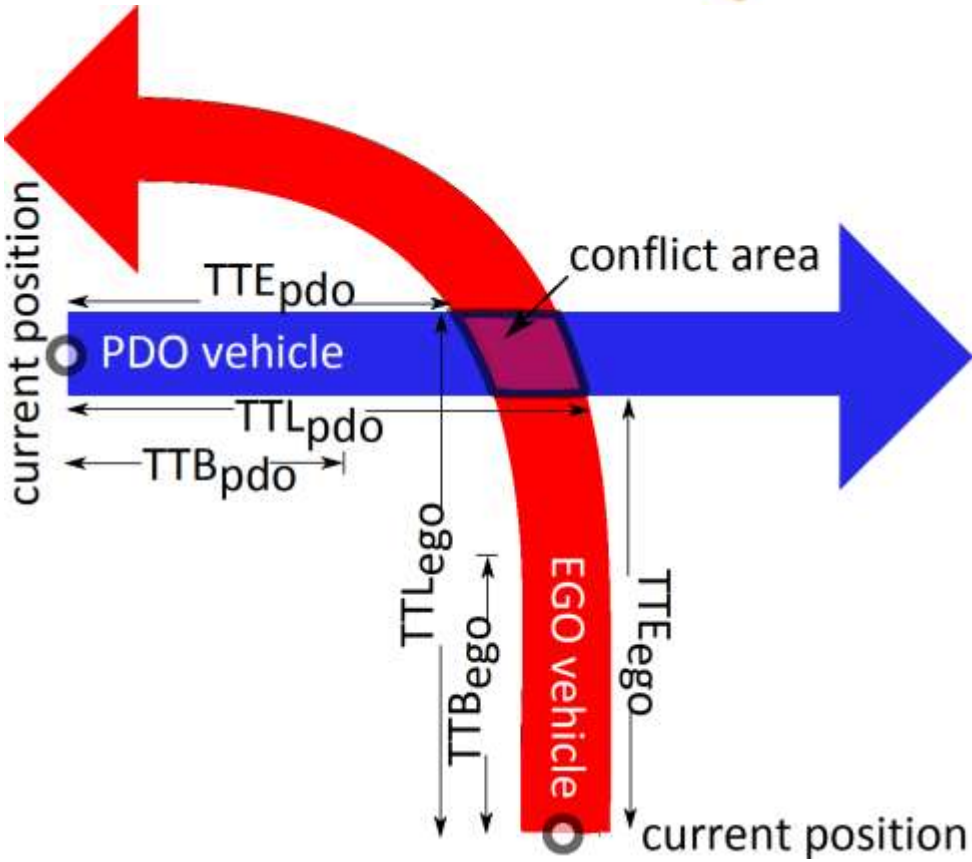


* Digital Map: Roland Krzikalla, SICK

** Paths Prediction: Dominik Petrich, Daimler

Situation Features

- SL – Significance level of a predicted path*
- TTx = {TTE, TTL} – Time to Enter/Leave the conflict area
- TTB** - Time to brake to avoid the collision



* SL: Dominik Petrich, Daimler

** TTB: Computation based on Forward Simulation, Daimler

PDO* - *Perceived Dynamic Object*

Method to Resolve the Challenges

Data uncertainties → Method for probabilistic reasoning

Object-oriented Bayesian Networks (OOBN)

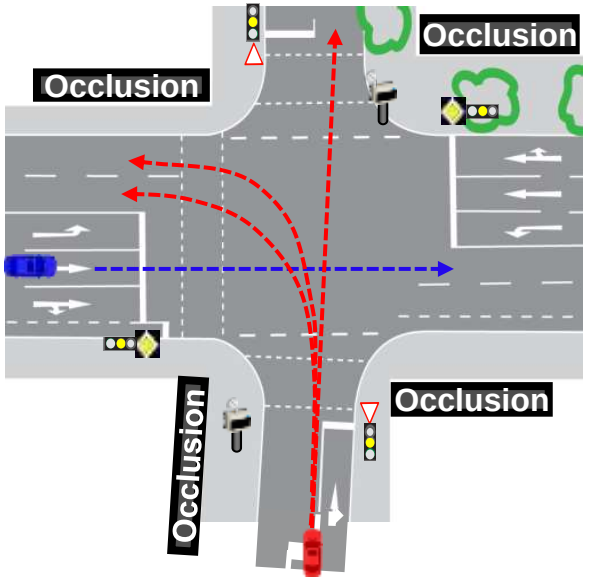
- Appropriate knowledge representation
- Reduction of complexity by

  model library of fragments

  →Reuse or modify in similar situation context

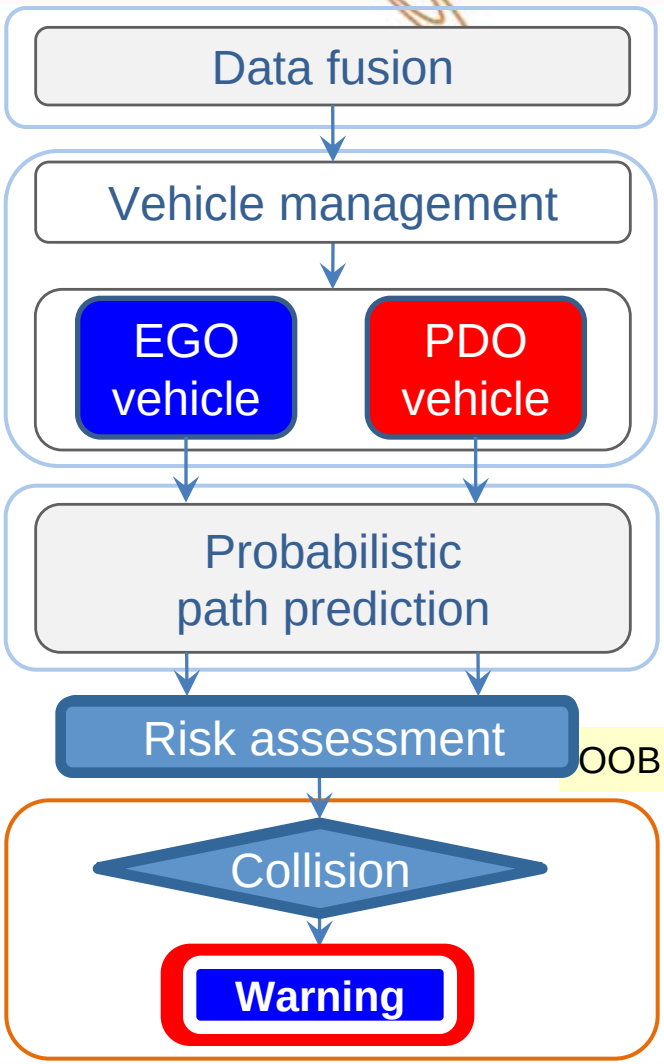
  →Easily extendable

- Mimic human reasoning



The System Approach on Situation Analysis

- Cooperative environment*
- Fuse data (collected from sensors)**
- Select relevant vehicles
- Assign road-lanes to vehicles
- Predict forward paths of vehicles***: SL
- Intersect paths to detect conflict area
- Extract the situation features: TTx
- Use OOBN for risk assessment
- Generate the warning



* Ko-PER

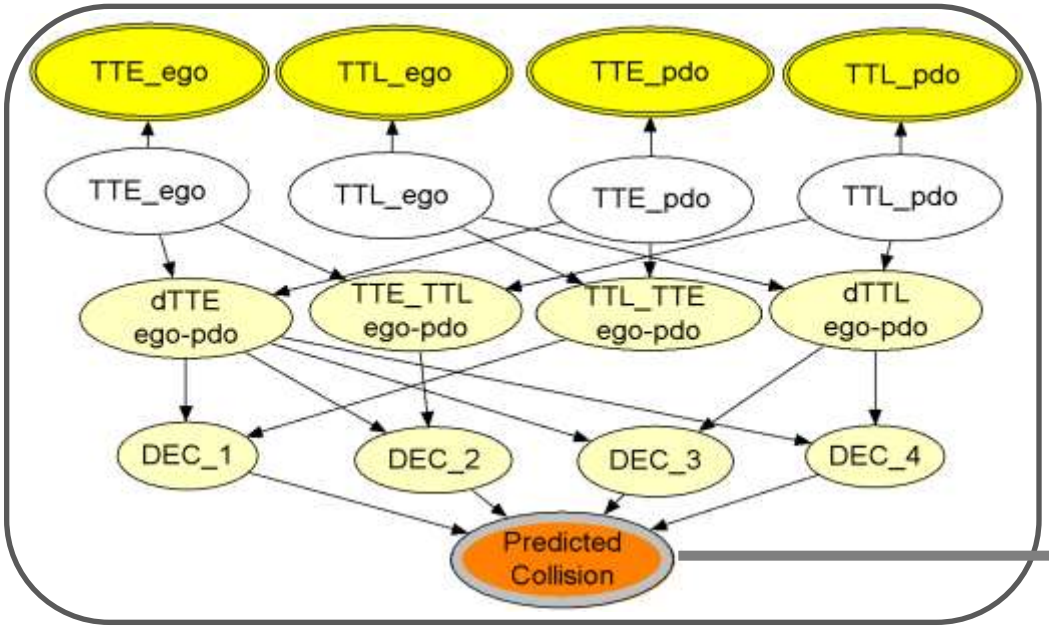
** Data Fusion: Florian Seeliger, MRM/driveU – Uni Ulm

*** Paths Prediction: Dominik Petrich, Daimler

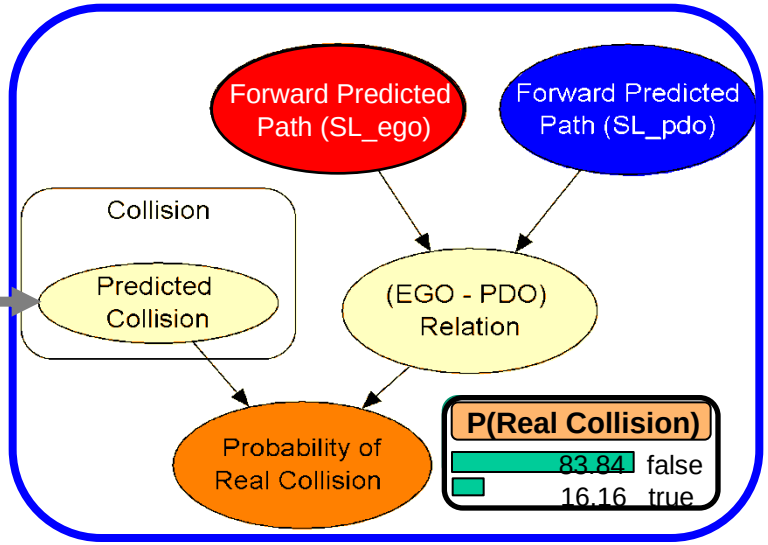
Situation Interpretation and Risk Analysis

FORSCHUNGSINITIATIVE KO-FAS

Object-oriented Bayesian Networks for Recognition of Potential Collisions and for Risk Assessment of Real Collisions



Warning Condition:
ISSUE WARNING when
Collision Probability > 0.80
and TTB ≤ 2sec



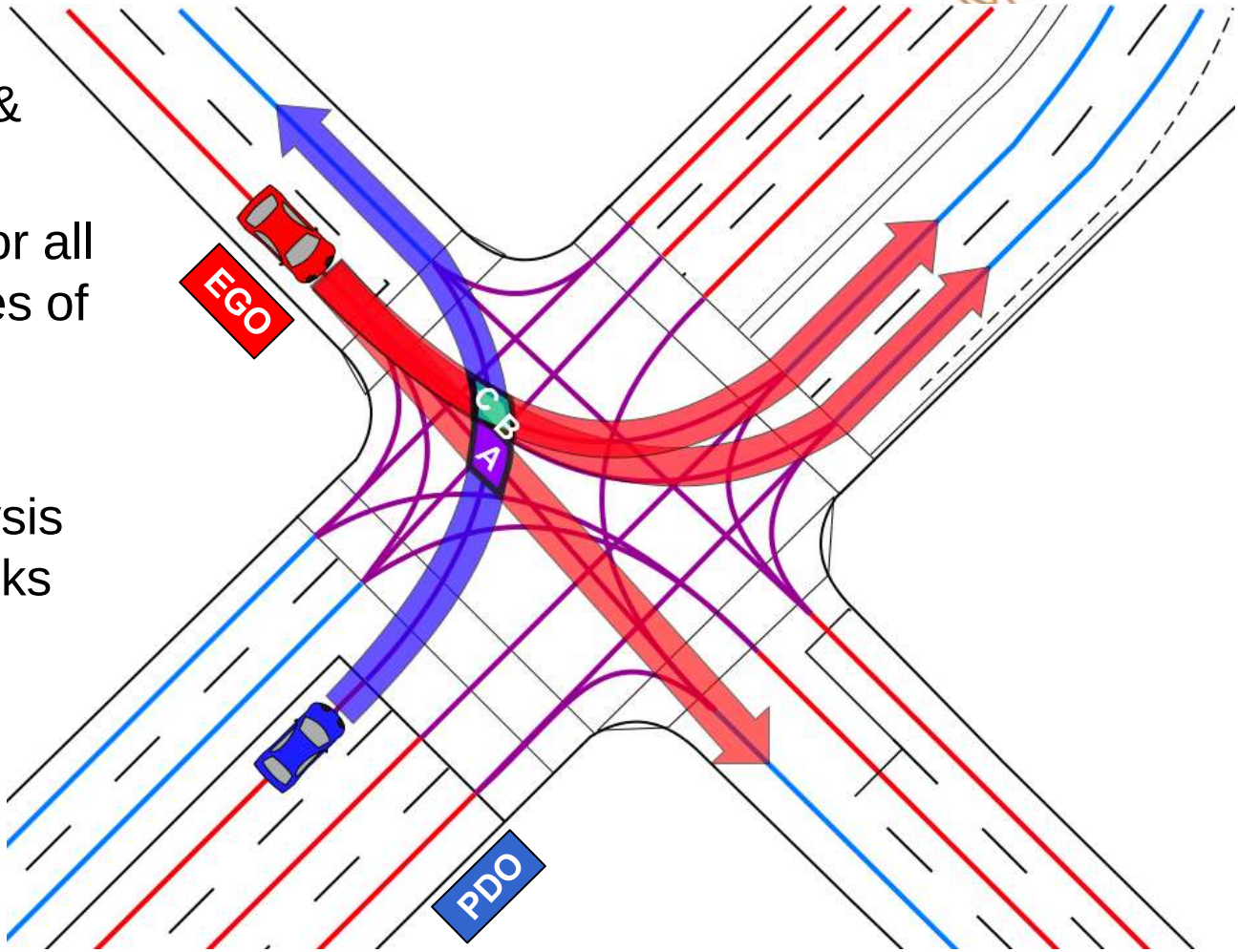
Bayesian variable

Time values based on continuous Gaussian distributions

Real Traffic Situation and Risk Analysis

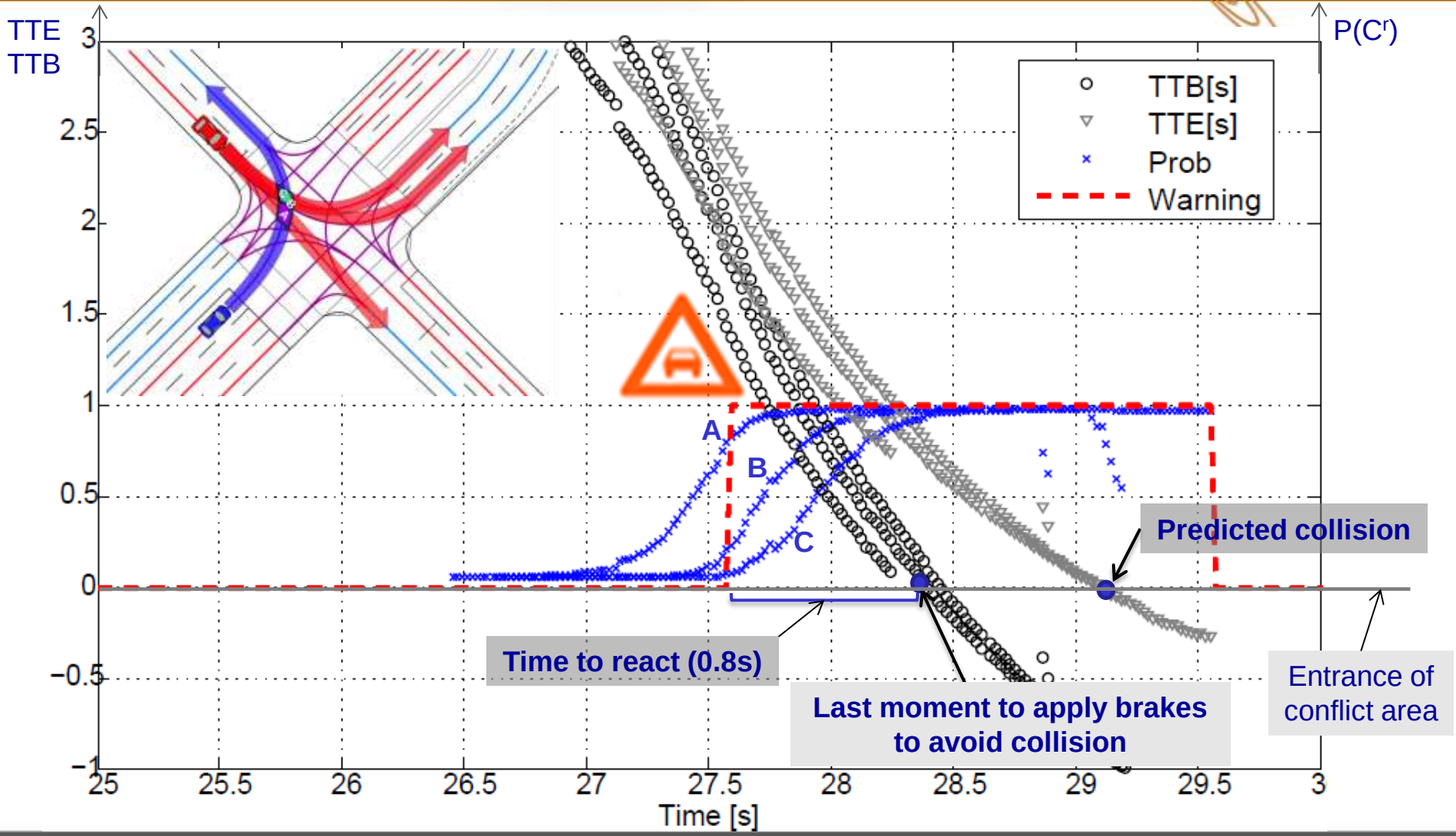
- Integration of FMP & OOBN
- Situation Analysis for all plausible hypotheses of relevant objects

→ Collision Risk Analysis by Bayesian networks under uncertainties



FMP = Forward Motion Prediction

Test Result: Evaluation of Risk in a Collision Situation with Warning



Video of Demonstration Scenario 1 on the Aschaffenburg Intersection

FORSCHUNGSINITIATIVE
K O - F A S

Crossing

Video of Demonstration Scenario 2 on the Aschaffenburg Intersection

Left Turn Across Path

Summary

- Scalable system approach
- A novel combination of forward path prediction with object-object relations for risk assessment, allowing reliable *risk assessment*
- Hierarchical object-oriented modeling

  →Creation of model libraries with generic OOBN-fragments

Successfully deployed and tested in the experimental vehicle

Questions?

FORSCHUNGSINITIATIVE
K O - F A S

Thank you!