FORSCHUNGSINITIATIVE
KO-FAS

Evasion Maneuver for Collision Avoidance and Mitigation at Intersection Scenarios

Notausweichen zur Kollisionsvermeidung und -folgenlinderung in Kreuzungsszenarien

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Motivation / State of Art

Source: www.roadsafety.ca.za

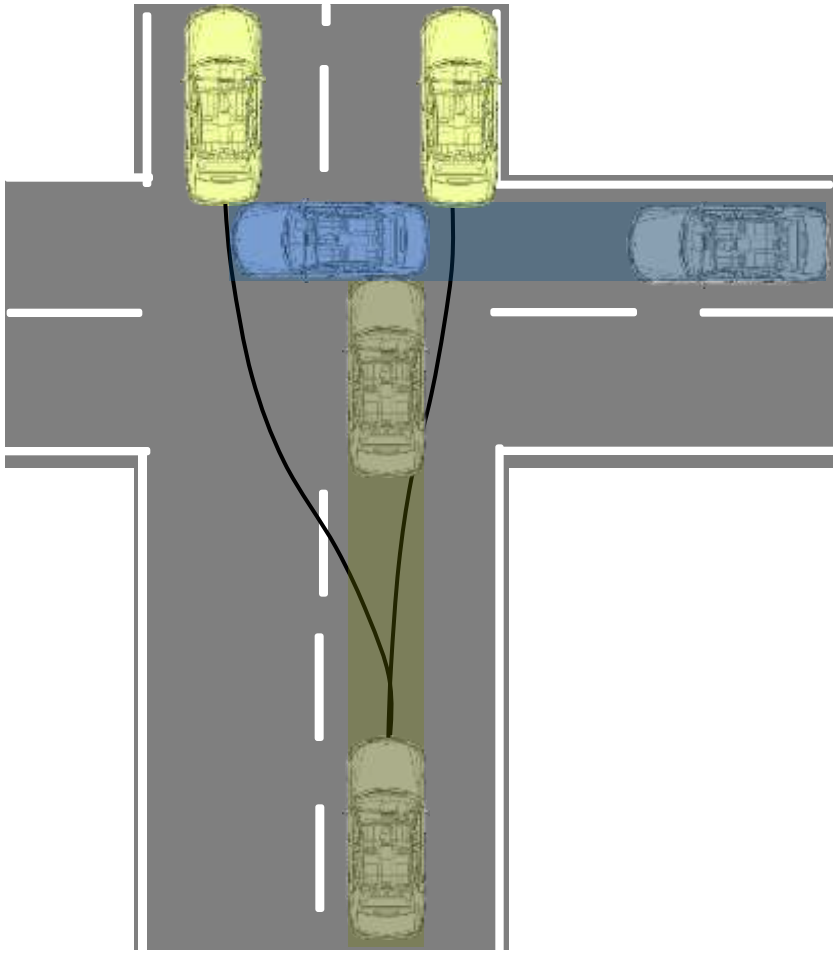
Focus of Research

- Potential of evasion maneuvers in crossing scenarios for…
  - … Collision Avoidance
  - … Collision Mitigation - by optimizing the Collision constellation (Ensuring a collision outside the passenger compartment)

Restrictions:

- **Accurate Environment Detection**
- **No Oncoming Traffic**

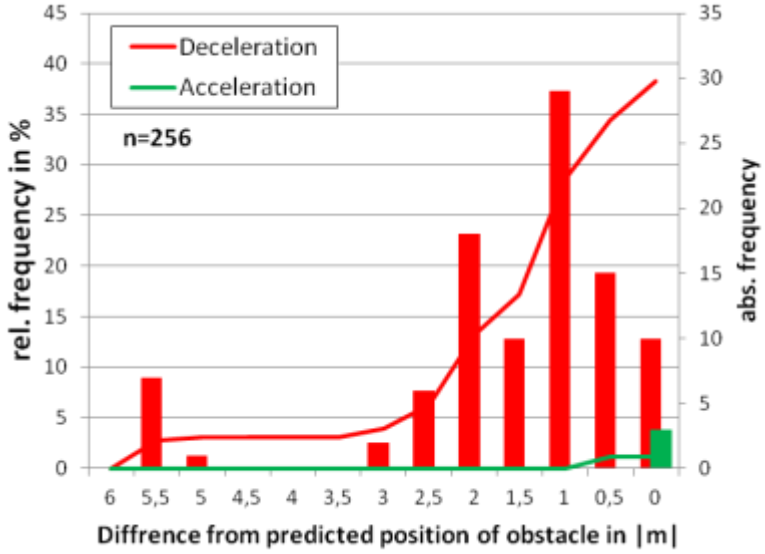
Direction of Evasion?



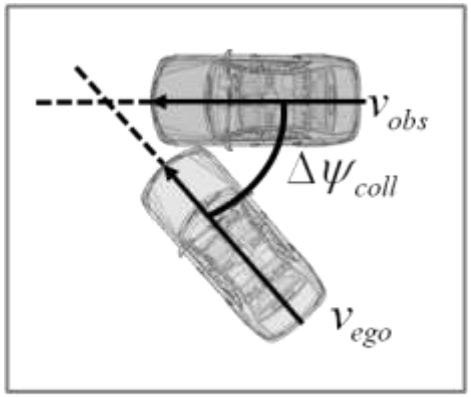
?

Direction of Evasion

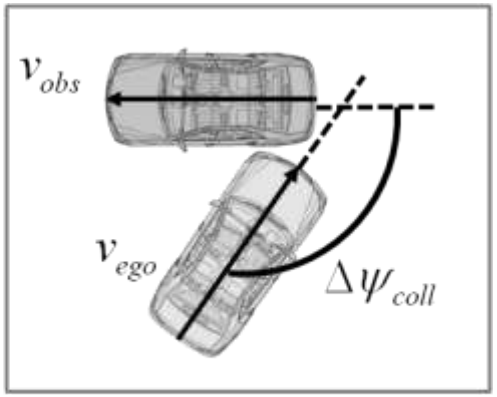
- Collision Avoidance
  - Higher potential for evading against direction of the obstacles movement
  - But: problems with validation due to unexpected actions of the obstacle



- Collision Mitigation



into direction of movement

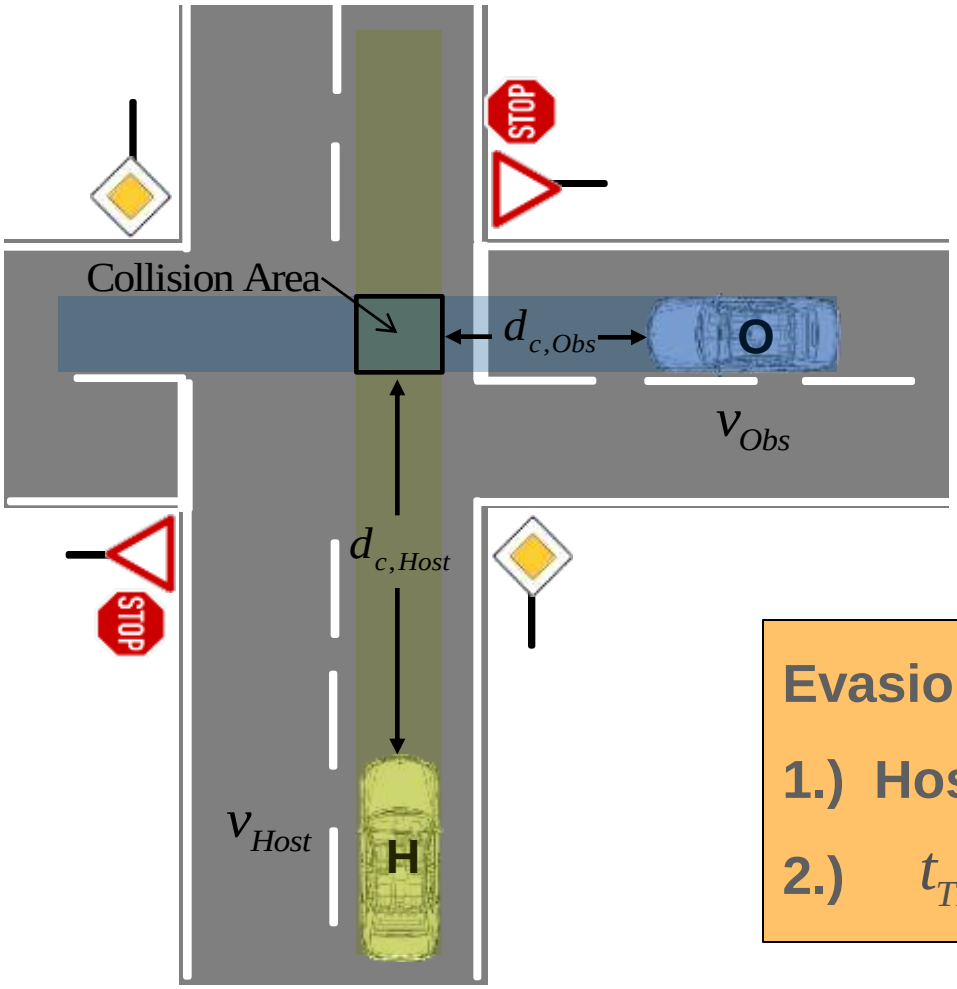


against direction of movement

  - Reduction of collision angle
  - Potential for avoiding the collision due to „cooperative behavior of the obstacle“

Evasion into the direction of the movement of the obstacle

Braking or Evading?



$$t_{TR,i} = \frac{d_{c,i} - d_{b,i}}{v_i}$$

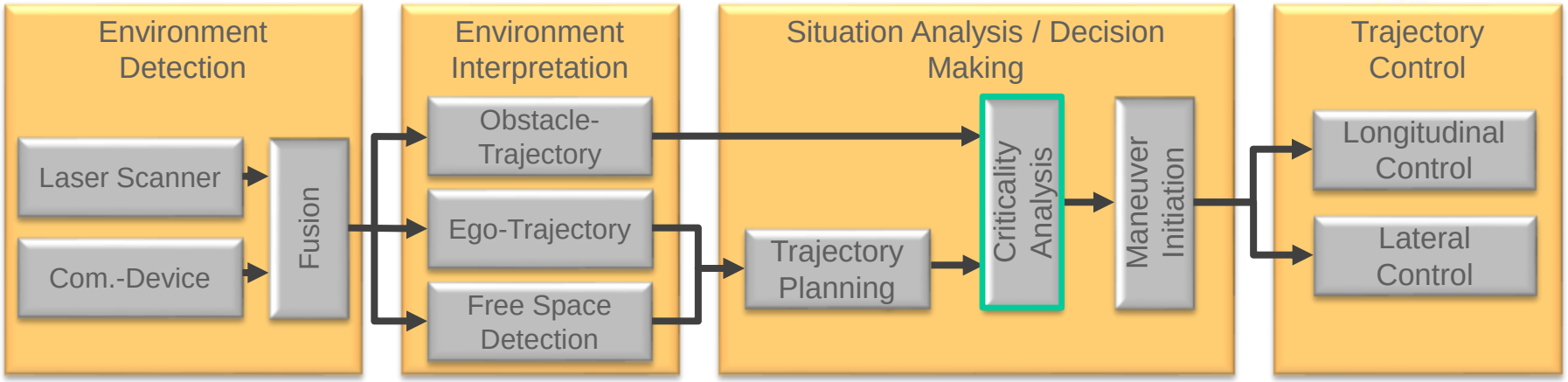
$$d_{b,i} = \frac{v_i^2}{2 \cdot a_{\max}}$$

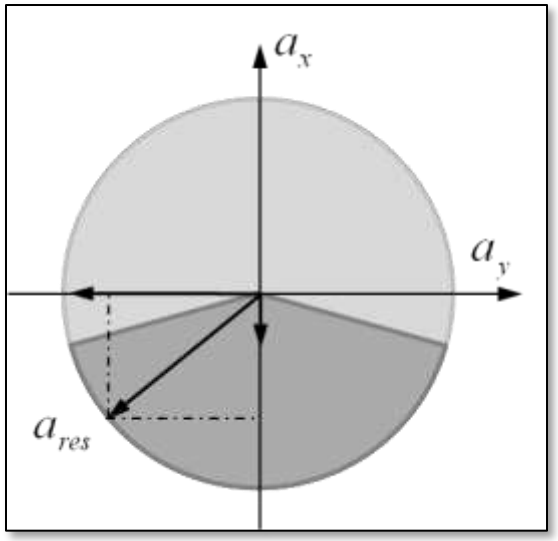
Evasion Maneuver →

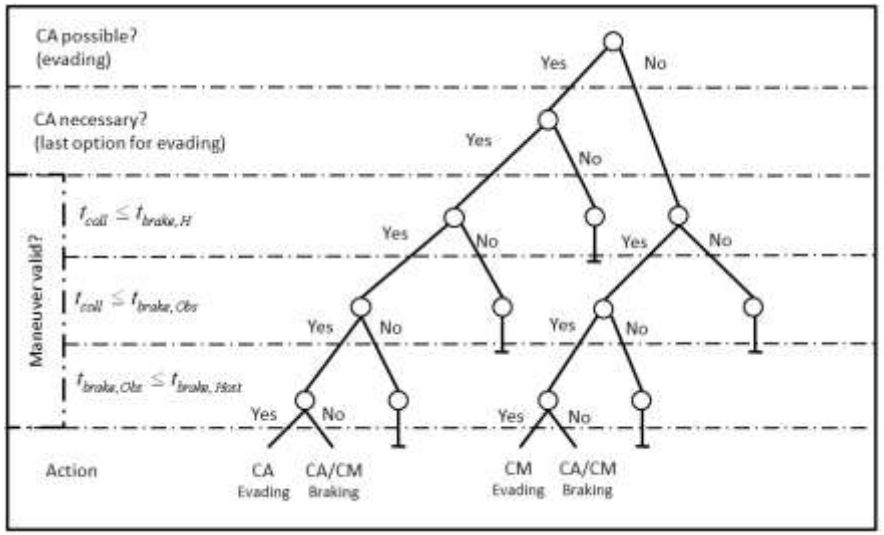
1.) Host vehicle has the right of way

2.) $t_{TR,Host} < t_{TR,Obs}$

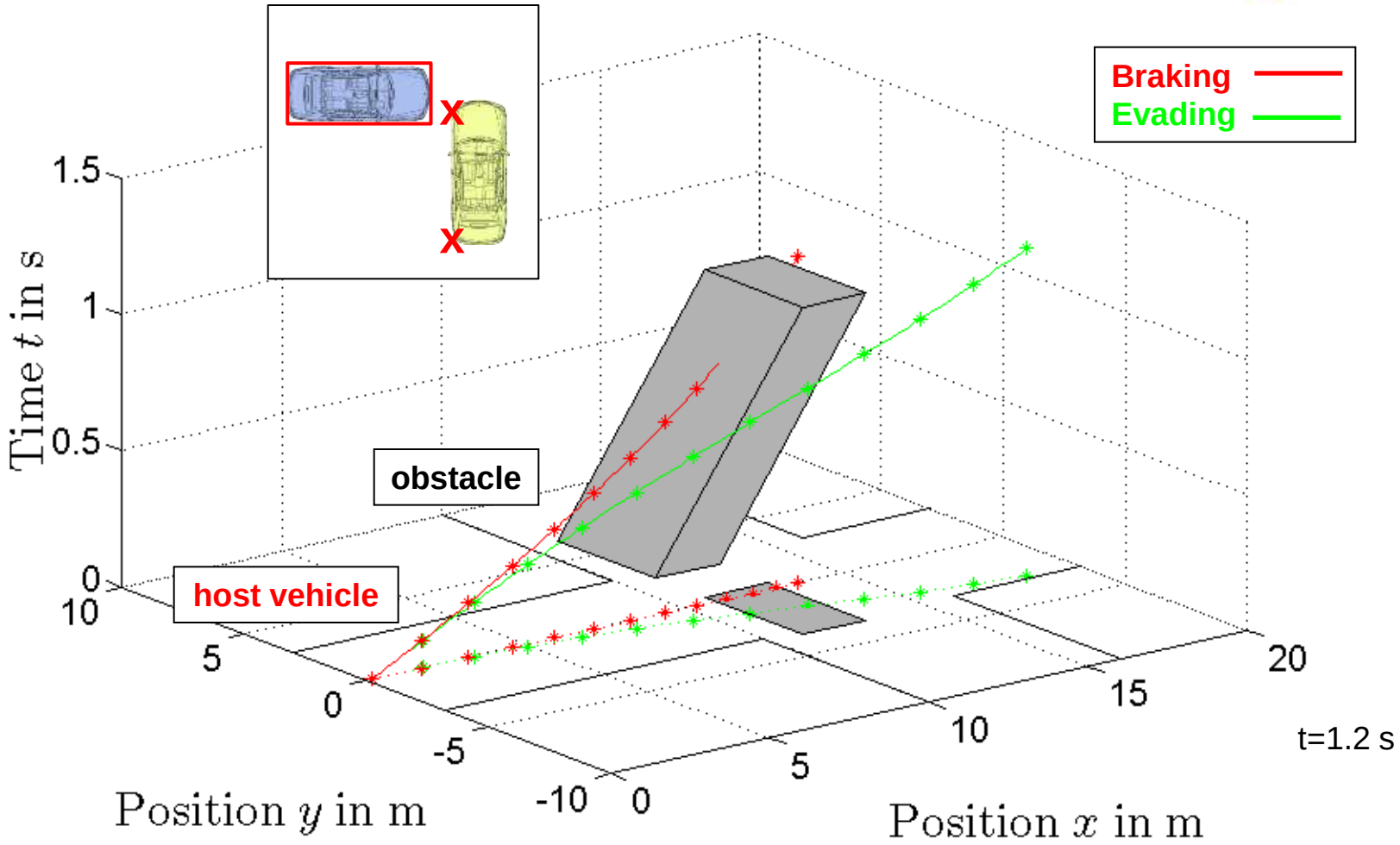
Systemarchitecture



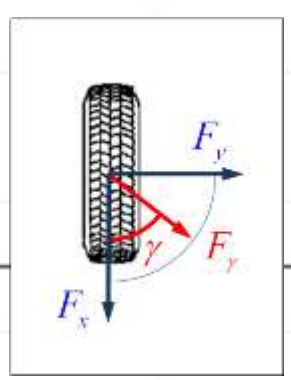


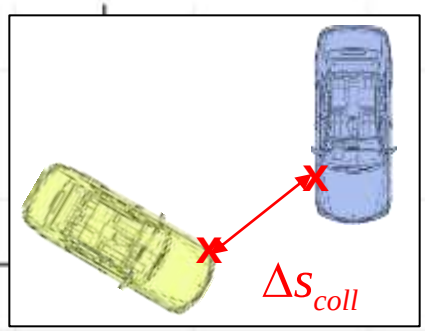


Situation Analysis - CA



Situation Analysis - CM

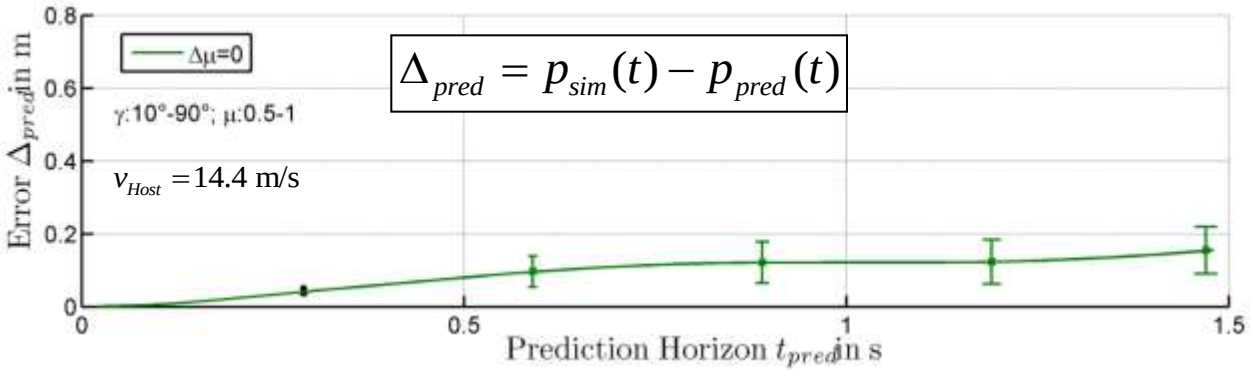


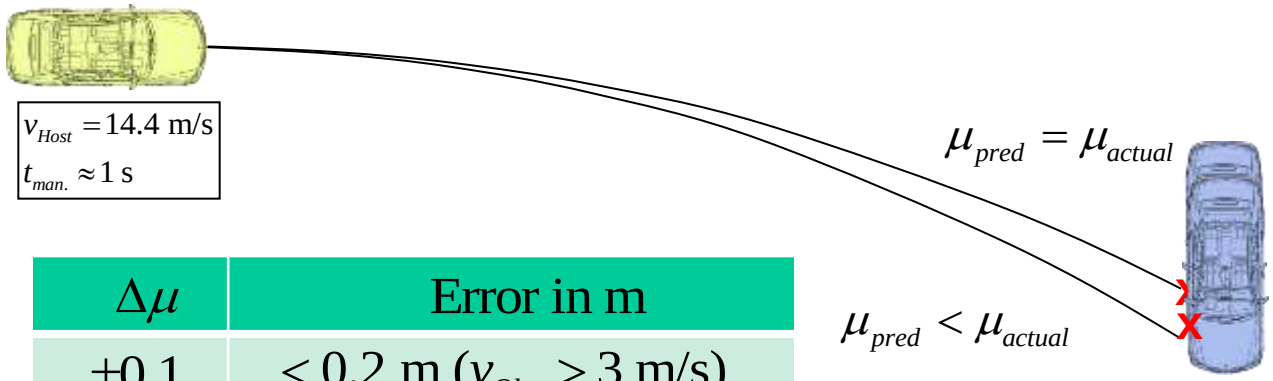


$$\Delta s_{ij,i=1,\ldots,n,\,j=1,\ldots,m} = \left| p_{Coll.j} - p_{ij} \right|$$

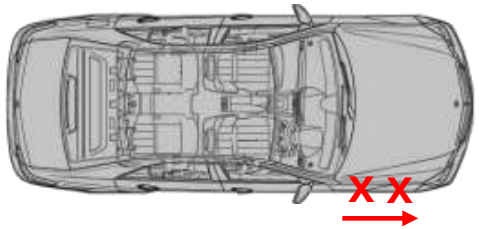
$$S_{TC} = \min(\Delta s_{ij,i=1,\ldots,n,\,j=1,\ldots,m})$$

Validation of Prediction





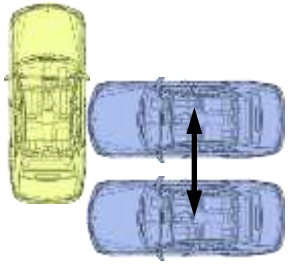
$\Delta\mu$	Error in m
±0.1	< 0.2 m ($v_{Obs} > 3$ m/s)
±0.2	< 0.3 m ($v_{Obs} > 4.5$ m/s)



Shifting of target collision point more to the front of the obstacle

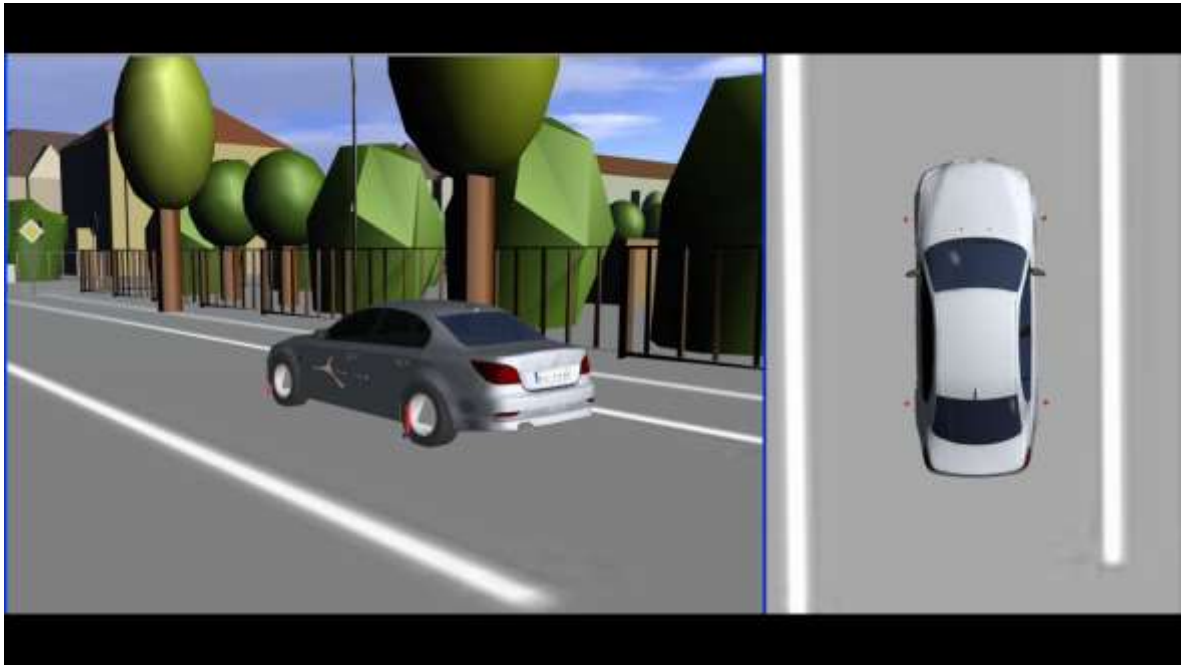
Results - CA

- Constellation
  - enough open space
  - $v_{host} \gg v_{obs}$

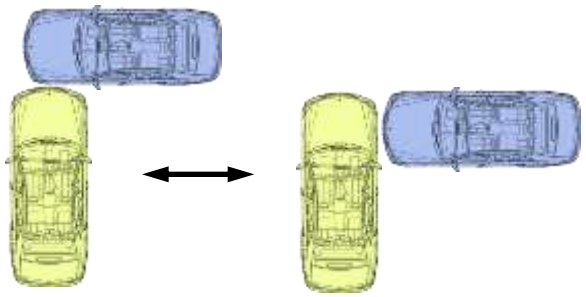


Approx. 5.5 % of all accidents at crossing scenarios could be avoided by evasion maneuvers

Results - CM



- Constellation
  - $v_{host} \geq v_{obs}$



In approx. 25.8 % of all accidents at crossing scenarios an evasion maneuver for collision mitigation could be initiated

Summary / Outlook

Evasion only into the direction of the movement of the obstacle

Evasion only in cases $t_{TR,Host} < t_{TR,Obs}$

In total approx. 30 % of all accidents at crossing scenarios are relevant use cases for Evasion Maneuvers

- But there are still some demanding challenges, concerning…
  - … the environment detection
  - … oncoming traffic
    - limiting the effectiveness of the safety functionality
    - potential source of new traffic accidents

Thank you for your Attention!