

Vehicle Dynamics

Dynamic Parameters



$$\mathcal{X} = [L_x \ L_y \ v_x \ v_y \ \theta \ r]^T$$

ADAS Applications

Longitudinal

ACC

AEB

Lateral

LKA

AES

Warning

FCW

.....

Reachability-based Verification

Hybrid Automata

Constant Cruising

$$\text{ConInt } \mathcal{U} = [F_y \ \delta]^T$$

$$\text{ConOut } \mathcal{Y} = [L_x \ L_y \ v_x \ v_y \ \theta]^T$$

Adaptive Cruising

$$\text{ConInt } \mathcal{U} = [F_y \ \delta]^T$$

$$\text{ConOut } \mathcal{Y} = [L_x \ L_y \ v_x \ v_y \ \theta]^T$$

Emergency Braking

$$\text{ConInt } \mathcal{U} = [F_y \ \delta]^T$$

$$\text{ConOut } \mathcal{Y} = [L_x \ L_y \ v_x \ v_y \ \theta]^T$$

Reachability Analysis

Specifications

Longitudinal
Constraints

Lateral
Constraints

Satisfy?

Extra
Guidance

Reachable
Sets

Intersected
Sets

Verified

End

Falsified

DRL-based Falsification

Reward Shaping

Intersected
Sets

Sequential least
squares programming

Fitted
Ellipse

Deep Reinforcement Learning

Agent

Action

Environment

Observation

Reward/Penalty

Counterexamples

Unsafe Conclusions
for Verification

+

Feasible Attack Paths
for Falsification