KI WISSEN
Automotive AI Powered by Knowledge

3.9 Traffic Sequence Charts for Knowledge Formalization and AI Application

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Classification of Declarative Knowledge

We analyzed the TSC artifacts and categorize relevant knowledge along modality:

- Aux. verbs: “must”, “can”, “should”, “may”
- Adverbs: “necessarily”, “possibly”
- Main verbs: “to be”, “to know”, “to believe”

Figure 1 lists knowledge types with example and shows their formalizability with TSCs. We call this knowledge **declarative**, because it describes *what* (Ontology) kind of traffic objects *should* or *must* (Script, Deontic) do under *which* (Physical Evolution) physical possibilities.

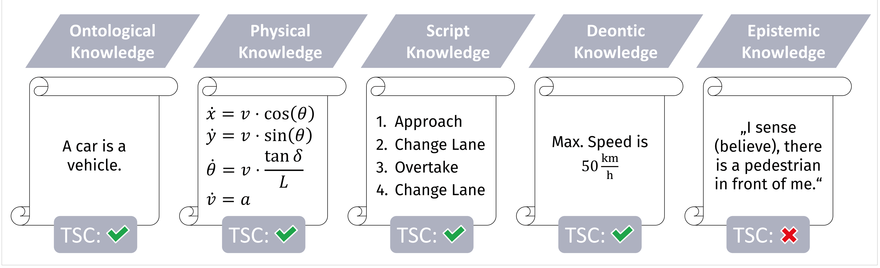

Figure 1: Classification of declarative knowledge and TSC formalization capability (© DLR e.V.)

From Declarative to Performative Knowledge via Reinforcement Learning (RL)

The original intention behind TSCs is to specify *what* scenarios are to be realized. One approach to close the gap on *how* to solve a TSC scenario is to train a RL agent in order to perform maneuvers satisfying the TSCs.

Training Environment

- *Ego* and *Other* on a *Road* with two *Lanes*
- *Ego* is modeled with Bicycle Model

Action Space

- Acceleration a_{ego}
- Steering δ_{ego}

Reward Function

$$R = \begin{cases} 1 & \text{if } \varphi_E, \\ 0.75 & \text{if } \varphi_D \wedge \neg\varphi_E, \\ 0.5 & \text{if } \varphi_C \wedge \neg\varphi_D \wedge \neg\varphi_E, \\ 0.25 & \text{if } \varphi_B \wedge \neg\varphi_C \wedge \neg\varphi_D \wedge \neg\varphi_E, \\ 0 & \text{if } \varphi_A \wedge \neg\varphi_B \wedge \neg\varphi_C \wedge \neg\varphi_D \wedge \neg\varphi_E, \\ -1 & \text{otherwise.} \end{cases}$$

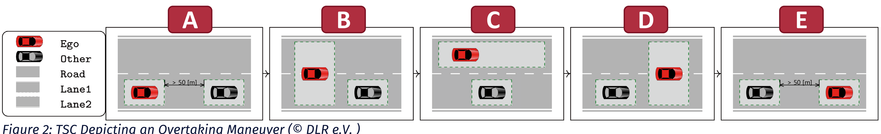

Figure 2: TSC Depicting an Overtaking Maneuver (© DLR e.V.)

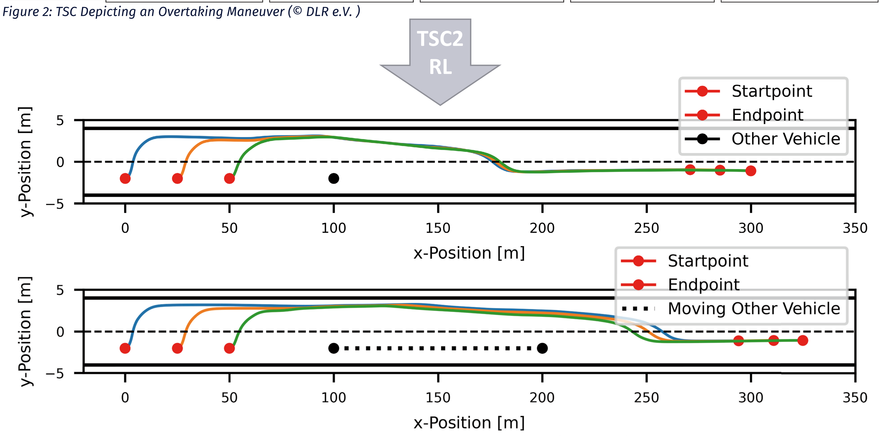

Figure 3: Trajectories of an Reinforcement Learning Agent performing a overtaking maneuver (© DLR e.V.)

References

[1] Becker et al. (2022) Simulation of Abstract Scenarios: Towards Automated Tooling in Criticality Analysis. In: Autonomes Fahren. Ein Treiber zukünftiger Mobilität Zenodo. Pages 42-51. doi: 10.5281/zenodo.5907154.

Partners

External partners

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