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Titel des Beitrags: Addressing Inherent Uncertainty: Risk-Sensitive Behavior Generation for Automated Driving using Distributional Reinforcement Learning

Abstract: For highly automated driving above SAE level 3, behavior generation algorithms must reliably consider the inherent uncertainties of the traffic environment, e.g. arising from the variety of human driving styles. Such uncertainties can generate ambiguous decisions, requiring the algorithm to appropriately balance low-probability hazardous events, e.g. collisions, and high-probability beneficial events, e.g. quickly crossing the intersection. State-of-the-art behavior generation algorithms lack a distributional treatment of decision outcome. This impedes a proper risk evaluation in ambiguous situations, often encouraging either unsafe or conservative behavior. Thus, we propose a two-step approach for risk-sensitive behavior generation combining offline distribution learning with online risk assessment. Specifically, we first learn an optimal policy in an uncertain environment with Deep Distributional Reinforcement Learning. During execution, the optimal risk-sensitive action is selected by applying established risk criteria, such as the Conditional Value at Risk, to the learned state-action return distributions. In intersection crossing scenarios, we evaluate different risk criteria and demonstrate that our approach increases safety, while maintaining an active driving style. Our approach shall encourage further studies about the benefits of risk-sensitive approaches for self-driving vehicles.

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