A Self-Learned Arbitration Between Model-Based and Model-Free Navigation Strategies in Autonomous Driving

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Abstract

Neuroscience research shows that mammals use two systems in spatial navigation: a flexible model-based strategy and a spontaneous model-free strategy. Mammals shift from model-based to model-free strategy as skills become ”habitized” and mostly use model-based strategy when high-level planning is necessary. Inspired by this line of work, the present study proposes a model with a novel arbitration structure that solves the navigation problem in the autonomous-driving domain. This model takes into account the information from a model-based mapping/planning system and a model-free reactive controller, and adopts a learning-based gating method to adaptively arbitrate between the two systems. Experiments show that the agent generally uses the reactive system when following lanes and driving through familiar intersections, and tend to rely on the planning system at unfamiliar intersections to get information about turning directions. The results are similar to mammal behaviors and provide insight for autonomous driving in the real world.