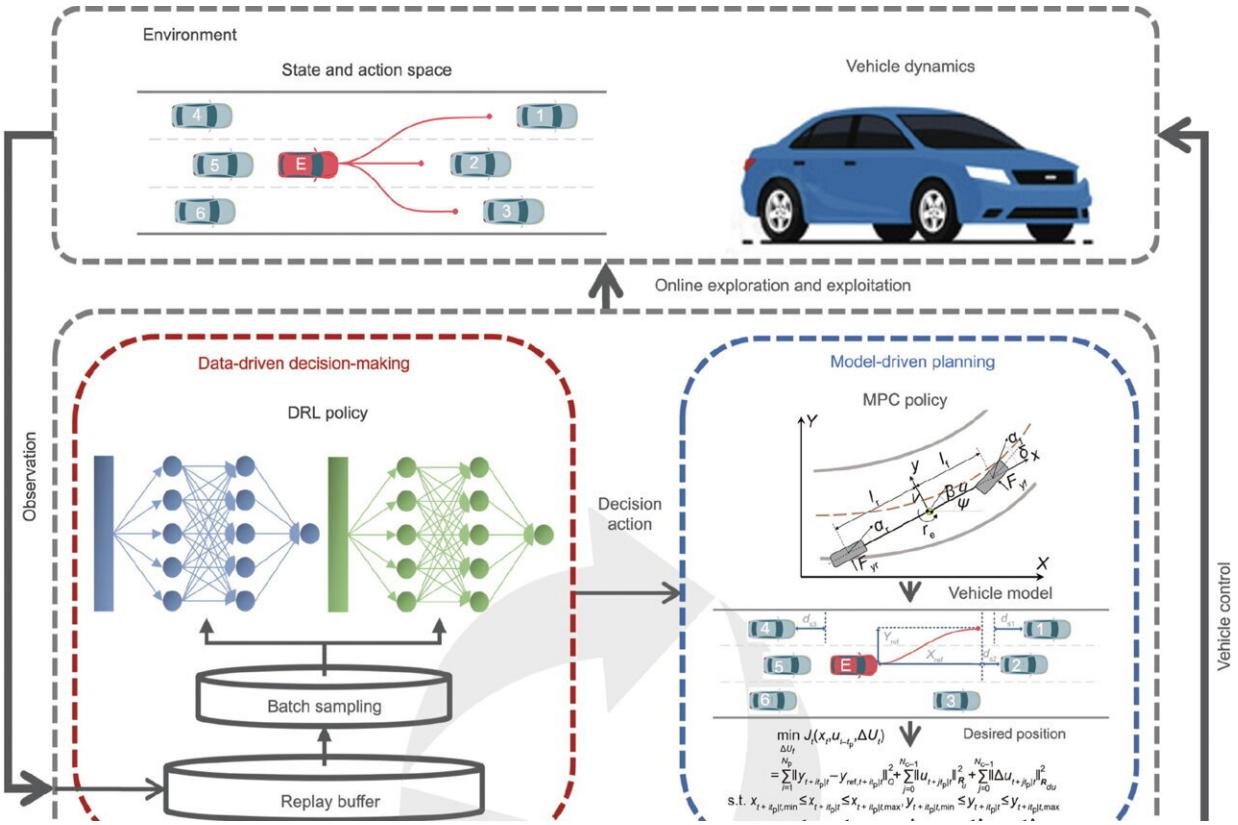
Researchers pioneer evolutionary decision-making for safer autonomous driving

September 21 2023



The formulas and parameters in the figure are defined in the paper. LatMP: the lateral motion planning module; LonMP: the longitudinal motion planning module. Credit: Kang Yuan et al.

New research published in the journal *Engineering*, presents a novel online evolutionary decision-making and motion planning framework

that ensures safe and rational driving in real-world environments. Tongji University's research team, led by Yanjun Huang and Hong Chen, has made significant progress in the field of autonomous driving with their latest research article titled "Evolutionary Decision-Making and Planning for Autonomous Driving Based on Safe and Rational Exploration and Exploitation."

The study addresses the crucial aspects of decision-making and motion planning in autonomous driving, aiming to enhance safety and efficiency. The research team has developed a hybrid data- and model-driven approach, combining deep reinforcement learning (DRL) for decision-making and model predictive control (MPC) for motion planning. This framework enables the autonomous vehicle to make rational driving decisions while adhering to multiple constraints defined by the vehicle's physical limits.

The research team proposes two principles for safety and rationality in the online evolution of autonomous driving. Based on the above framework, a safe-driving envelope is established, and a rational exploration and exploitation scheme is designed that filters out random and unsafe experiences by masking unsafe actions in order to obtain high-quality training data and realize the safe and rational self-evolution of autonomous driving. Based on a safe online-learning mechanism, the continuous evolution of the system within the capability boundary of the planning layer is realized, along with the maximum utilization of the capabilities of the planning layer.

To validate their framework, the research team conducted experiments using a high-fidelity vehicle model and a MATLAB/Simulink co-simulation environment. The results demonstrate that the proposed online-evolution framework generates safer, more rational, and more efficient driving actions in real-world environments.

The research article concludes with future directions for their work. The team plans to enable the agent to learn the MPC parameters, enhancing the flexibility of decision-making and motion planning. Additionally, they aim to investigate more driving tasks under this framework and conduct real vehicle experiments.

This research by Yanjun Huang and Hong Chen's research team at Tongji University represents a significant advancement in the field of autonomous driving. Their innovative framework for evolutionary decision-making and motion planning not only ensures safe and rational driving but also contributes to improving traffic efficiency.

More information: Kang Yuan et al, Evolutionary Decision-Making and Planning for Autonomous Driving Based on Safe and Rational Exploration and Exploitation, *Engineering* (2023). DOI: 10.1016/j.eng.2023.03.018

Provided by Tongji University