

Interactive Path Planning for Autonomous Systems in Dynamic Environments

Tech ID: 34784 / UC Case 2025-473-0

ABSTRACT

Researchers at the University of California, Davis have developed a framework that enables autonomous systems to plan paths while accounting for how their actions influence surrounding actors. Unlike existing approaches that rely on reactive planning with fixed predictions or on computationally intensive multi-agent formulations, this technology uses a structured, data-driven interaction model within a tractable theoretical framework. The approach is designed for real-time deployment and supports analyzable performance and safety behavior under defined conditions. It enables more adaptive navigation in environments shared with people or other intelligent machines, improving operational efficiency, safety margins, and integration potential across a range of autonomous products.

FULL DESCRIPTION

Autonomous vehicles and robotic systems operate in dynamic environments where their actions influence the behavior of nearby actors such as drivers, pedestrians, cyclists, or other machines. Existing planning methods often assume fixed future trajectories for surrounding actors or treat interaction only as a downstream correction, which can lead to unnecessarily conservative, inefficient, or brittle behavior. This invention addresses that limitation by incorporating likely agent responses directly into the planning process, enabling the autonomous system to evaluate candidate actions in light of how surrounding actors are expected to react. The result is more adaptive and effective navigation in mixed human-machine environments.

The technology introduces a high-level decision framework that represents surrounding actors as responsive agents whose behavior adapts to the autonomous system's planned actions. This allows complex multi-agent interactions to be handled within a streamlined planning workflow suitable for real-time use. The approach fits within existing autonomy stacks and can be integrated into vehicle, robot, or mobility platforms through software updates. It can also support planning workflows that combine predictive modeling with downstream planning or control modules. By reducing unnecessary conservatism while maintaining appropriate safety considerations, the framework can improve throughput, reduce delays, and enhance overall system performance. These benefits are especially important for commercial deployment in dense or unpredictable operating conditions.

APPLICATIONS

- ▶ Autonomous passenger vehicles and advanced driver assistance systems (ADAS).
- ▶ Robotic mobility platforms in logistics, delivery, or service settings.
- ▶ Industrial collaborative robots operating near people.
- ▶ Healthcare and assistive robotic systems.
- ▶ Autonomous racing or testing platforms.
- ▶ Multi-agent autonomous systems for security or defense applications.

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OTHER INFORMATION

KEYWORDS

autonomous mobility,
autonomous vehicles,
behavior prediction,
interactive planning,
human-robot interaction,
interactive navigation,
motion planning, multi-agent systems, path planning, real-time decision making, robotics software

CATEGORIZED AS

- ▶ **Engineering**
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- ▶ [Other](#)

FEATURES/BENEFITS

- ▶ Interaction-aware planning – accounts for likely surrounding-actor responses during path planning.
- ▶ Real-time decision capability – supports deployment in operational environments.
- ▶ Reduced unnecessary conservatism – can improve throughput and mission performance.
- ▶ Broad platform compatibility – fits within existing autonomy architectures.
- ▶ Scalable multi-agent handling – supports more complex operating scenarios.
- ▶ Software-based integration – supports incorporation into existing prediction, planning, and control pipelines.

PATENT STATUS

Patent Pending

▶ [Robotics and Automation](#)

▶ **Computer**

▶ [Software](#)

▶ **Security and Defense**

▶ [Other](#)

▶ **Transportation**

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