Learning-Enabled Assistive Driving (LEAD): Formal Assurances during Operation and Training

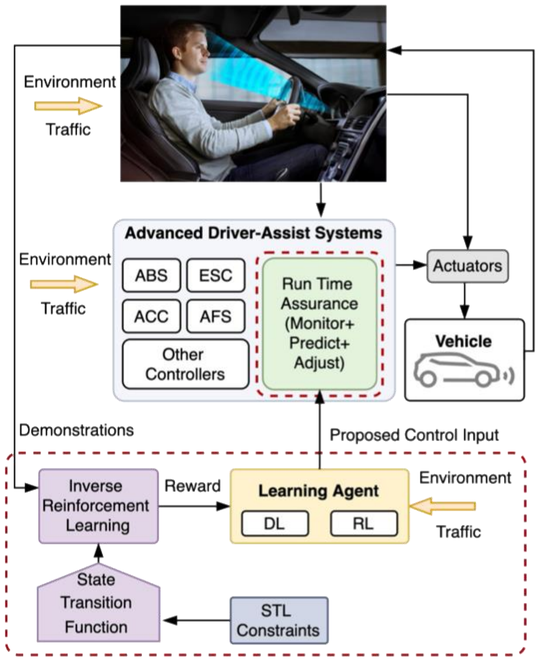
Panagiotis Tsiotras (PI, Georgia Tech), Samuel Coogan (Georgia Tech), Matthew Gombolay (Georgia Tech)

https://dcsl.gatech.edu/research/lead.html

Objective: Make learning-enabled **assistive driving technologies safer** and align their decisions with human-drivers; exhibit ”natural” behaviors by autonomous machines that are acceptable, safe, and understandable by humans; quantify impact of human driver within the autonomy loop, both from an individual experiential perspective, as well as in terms of safety.

Motivation/Challenges:

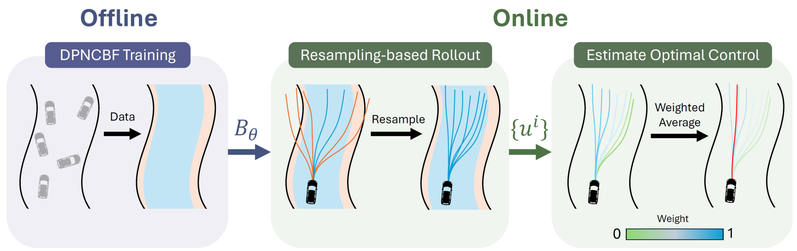
- **Misalignment** of learning agent’s goals with human driver can lead to unsafe interactions
- There is a need to **increase the robustness of learning-based approaches** without sacrificing safety



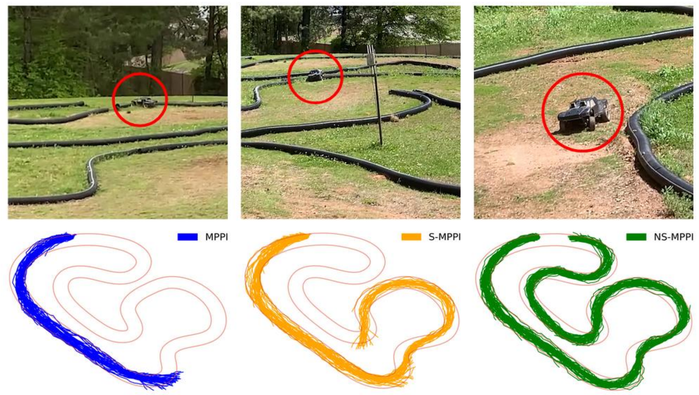
Overall Architecture

Scientific Impact:

- Develop “**personalized,” safe, and trustworthy autonomous systems**
- Fundamental contributions to **safe operation of deep learning** architectures during training and execution

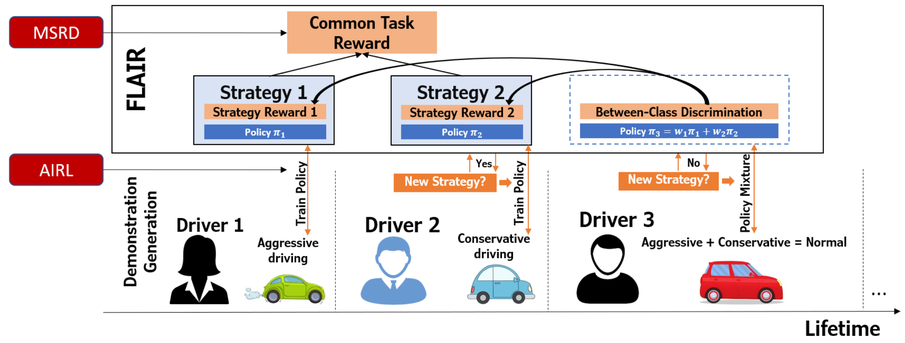


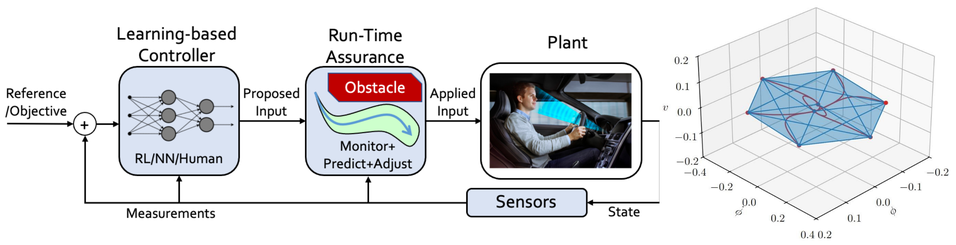
Using neural control barrier functions to make safer Variational Inference MPCs



(a) MPPI tracking 50m/s, collision at T2 (b)Shield-MPPI tracking 80m/s, collision at T7 (c) NS-MPPI tracking 80m/s without collisions

AutoRally experiments to validate safety of the proposed method





Efficient reachability analysis of neural network for safety during execution, and scalable training of safe neural network controllers

Impact on Society

- Safer ADAS and self-driving vehicles
- Better ADAS will decrease the 40,000 annual casualties from traffic accidents

Education and Outreach

- More than 120 undergraduate students via a Vertically Integrated Project Team (VIP)
- Industry collaboration and technology transfer

Broader Impacts

- Trustworthy, “personalized,” safe autonomous systems in human-machine collaborative settings

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