Graduate Student Research Seminar

Fall 2021

Embodied Sensing and Control for Agile Motion of Unmanned Ground Vehicles

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Monday, September 27th

3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

The influence of ground interactions on the dynamics of offroad vehicles poses a significant research challenge for autonomous navigation of such vehicles, especially considering that it is usually difficult to obtain complete and reliable information about the terrain. To enable efficient and agile autonomous motion, a deep reinforcement learning framework for an agile offroad vehicle requires modeling a coupled terrain-vehicle dynamic model. Such a model can then form the foundation for simultaneous estimation of uncertain terrain features and training autonomous agents that can traverse such terrain. Our efforts are geared towards developing vehicle-terrain interaction models and establishing the proof of concept for the estimation of terrain parameters and control of a simplified vehicle model to enable velocity tracking, chassis stabilization, and enhanced mobility of an unmanned ground vehicle. With the understanding that the vehicle dynamics encode real-time terramechanics data, the goal is to use an AI-based approach to dynamical systems to extract this knowledge of the terrain and use it to improve the vehicle performance. The broad themes of this thrust include (i) using proprioceptive sensor measurements to complement coarse terrain data from satellite, maps, or coordinating UAVs, which alone would lead to suboptimal performance; (ii) estimating or classifying the terrain using dynamic measurements from onboard sensors; (iii) using the identified terrain properties to reconfigure the physical vehicle or tune vehicle parameters to achieve enhanced performance and optimized agility, while achieving other path-tracking goals, such as velocity tracking and steering control.

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