Tuesday, February 16th
3:00 PM Bowen Hall Rm 222

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Control of agile robots in complex environments with formal safety guarantees

The goal of my research is to develop algorithmic and theoretical techniques that push highly agile robotic systems to the brink of their hardware limits while guaranteeing that they operate in a safe manner despite uncertainty in the environment and dynamics.

In this talk, I will describe my work on algorithms for the synthesis of feedback controllers that come with associated formal guarantees on the stability of the robot and show how these controllers and certificates of stability can be used for robust planning in environments previously unseen by the system. In order to make these results possible, my work connects deeply to computational tools such as sums-of-squares (SOS) programming and semidefinite programming from the theory of mathematical optimization, along with approaches from nonlinear control theory.

I will describe this work in the context of the problem of high-speed unmanned aerial vehicle (UAV) flight through cluttered environments previously unseen by the robot. In this context, the tools I have developed allow us to guarantee that the robot will fly through its environment in a collision-free manner despite uncertainty in the dynamics (e.g., wind gusts or modeling errors). The resulting hardware demonstrations on a fixed-wing airplane constitute one of the first examples of provably safe and robust control for robotic systems with complex nonlinear dynamics that need to plan in realtime in environments with complex geometric constraints.

Anirudha Majumdar is a Ph.D. candidate in the Electrical Engineering and Computer Science department at MIT. He is a member of the Robot Locomotion Group at the Computer Science and Artificial Intelligence Lab and is advised by Prof. Russ Tedrake. Ani received his undergraduate degree in Mechanical Engineering and Mathematics from the University of Pennsylvania, where he was a member of the GRASP lab. His research is primarily in robotics: he works on algorithms for controlling highly dynamics robots such as unmanned aerial vehicles with formal guarantees on the safety of the system. Ani's research has been recognized by the Siebel Foundation Scholarship and the Best Conference Paper Award at the International Conference on Robotics and Automation (ICRA) 2013.

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For inquiries, please contact the Dept. of Mechanical & Aerospace Engineering at 609-258-0315

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