PennState College of Engineering | Systems, Controls, and Robotics Seminar Series

Design and control of emergent oscillations for flapping-wing flyers and synchronizing swarms

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ABSTRACT

Locomotion in living systems and bio-inspired robots requires the generation and control of oscillatory motion. While a common method to generate motion is through modulation of time-dependent “clock” signals, in this talk we will motivate and study an alternative method of oscillatory generation through autonomous limit-cycle systems. Limit-cycle oscillators for robotics have many desirable properties including adaptive behaviors, entrainment between oscillators, and potential simplification of motion control. I will present several examples of the generation and control of autonomous oscillatory motion in bio-inspired robotics. First, I will describe our recent work to study the dynamics of wingbeat oscillations in “asynchronous” insects and how we can build these behaviors into micro-aerial vehicles. In the second part of this talk I will describe how limit-cycle gait generation in collective robots can enable swarms to synchronize their movement through contact and without communication. More broadly in this talk I hope to motivate why we should look to autonomous dynamical systems for designing and controlling emergent locomotor behaviors in bio-inspired robotics.

BIOGRAPHY

Nick Gravish received his PhD from Georgia Tech where he used robots as physical models to motivate and study aspects of biological locomotion. During his post-doc Gravish worked in the microrobotics lab at Harvard, where he gained expertise in designing and studying insect-scale robots. Gravish is currently an associate professor at UC San Diego in the Mechanical and Aerospace Engineering department. His lab bridges the gap between bio-inspiration, biomechanics, and robotics, towards the development of new bio-inspired robotic technologies to improve the adaptability and resilience of mobile robots.