

abstract

WORKSHOP ON TOPOLOGY: IDENTIFYING ORDER IN COMPLEX SYSTEMS

Topic:

Speaker:

Affiliation:

Date:

Time/Room:

My collaborators and I have spent a the better part of two decades seeking to develop formally and apply empirically methods of programming work: that is, we want to know how to say what we mean, yet mean what we say to a machine built for exchanging energy as well as information with its environment. As an example, tasks that can be encoded as point attractors admit a straightforward but broadly useful means of composing their associated controllers that amounts to the traditional backchaining operation from classical AI. For tasks encoded more generally, e.g., as limit cycles, it has not been clear how to extend such ideas. This talk introduces a new formalism for coordination of periodic tasks, with specific application to gait transitions for legged platforms. We decompose the space of all periodic legged gaits into a cellular complex indexed by Young Tableaux, making transparent the proximity to steady state orbits and the neighborhood structure. We address the simplest task of transitioning between these gaits while locomoting over level ground. Toward that end, we arrange a family of dynamical reference generators over the Gait Complex¹; and construct automated coordination controllers to force the legged system to converge to a specified cell's gait, while assessing the relative static stability of gaits by approximating their stability margin via transit through a Stance Complex. To integrate these two different constructs²; the Gait Complex describing possible gaits, the Stance Complex defining safe locomotion³; we utilize our compositional lexicon to plan switching policies for a hybrid control approach. Results include automated gait transitions for a variety of useful gaits, demonstrated via tests on a hexapedal robot