Abstract:

A system is passive if it neither generates nor dissipates energy; a mass-spring system is an example. A system is strictly passive if it dissipates energy; a damper is an example. Since a strictly passive system dissipates energy, a controller that emulates the dynamics of a strictly passive system is guaranteed to provide a stable control system when used for feedback with a passive system; this is the essence of passivity-based control.

In a linear time-invariant context, a strictly passive system has a strictly positive real (SPR) transfer function or matrix. In this talk I will first discuss the synthesis of SPR controllers that are optimal. In particular, by retooling the standard H2 control problem, SPR controllers that minimize the closed-loop H2 norm are synthesized by positing a convex optimization problem constrained by linear matrix inequalities (LMIs). Next, I will discuss the use of multiple SPR controllers within an interpolation or scheduling architecture to improve control performance. This type of nonlinear control is called gain-scheduled control. Using passivity concepts, closed-loop stability can be guaranteed when controlling nonlinear passive systems, such as a flexible robotic manipulator.