

Guest Lecture / Seminar - Professor J.-J. E. Slotine, Dept. of Mechanical Engineering, MIT

Time: Thursday 24 June 2004, 11.15 - 12:00 a.m.

Place: Room T3/T4, Marinteknisk Senter/CeSOS - Tyholt

Title: Application of contraction theory to synchronization, time delays and hybrid nonlinear systems

Abstract: Nonlinear contraction theory allows surprisingly simple analysis of synchronisation phenomena in distributed networks of coupled nonlinear elements. The key idea is the construction of a virtual contracting system whose particular solutions include the individual subsystems' states. We also study the role, in both nature and system design, of co-existing "power" leaders, to which the networks synchronize, and "knowledge" leaders, to whose parameters the networks adapt. Also described are applications to large scale computation using neural oscillators, and to time-delayed teleoperation between synchronized groups.

Similarly, contraction theory can be systematically and simply extended to address classical questions in hybrid nonlinear systems. The key idea is to view the formal definition of a virtual displacement, a concept central to the theory, as describing the state transition of a differential system. This yields in turn a compositional contraction analysis of switching and resetting phenomena. Applications to hybrid nonlinear oscillators are also discussed.