Prof. Yizhar Or

Faculty of Mechanical Engineering, Technion

Dynamics and control of (bio-) robotic locomotion: nonlinear, nonholonomic and hybrid mechanical systems.

Abstract:
Locomotion of mobile robots or moving creatures is generated by internal actuation of shape changes combined with physical interaction with the surrounding environment. The mechanics of locomotion typically gives rise to nonlinear control systems which are governed by nonholonomic constraints. In this talk, several (bio-) robotic locomotion systems will be overviewed: Swimming microorganisms and micro-robotic swimmers whose motion is governed by low-Reynolds-number hydrodynamics, in which inertial effects are negligible, can be controlled by internal motors or by actuation of external magnetic fields. Underactuated vehicles are governed by nonholonomic mechanics due to no-slip constraints of wheels, and their motion can be formulated as nonlinear control systems. The dynamics of legged locomotion involves nonsmooth transitions between different states of ground-foot contact, and can be formulated as hybrid systems. It will be shown how one can use simple models of the locomotion systems' dynamics and mechanical actuation in order to analyze their control and stabilization capabilities and optimize their performance.