THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Sliding Mode Control in Electromechanical Systems

MECHENG 7259

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Recitation
Lecture

Course Description:
Sliding modes an efficient tool to control high order dynamic plants operating under uncertainty conditions.

Prerequisites and Co-requisites:
Prereq: 5372 or ECE 5750 (750).

Course Goals / Objectives:
- Demonstrate the beneficial properties of sliding mode control which enables separation of the overall system motion into independent partial components of lower dimensions and low sensitivity to plant parameter variations and disturbances
- Sliding mode control studies span heterogeneous problems (mathematical methods, design principles, applications). Major attention will be paid to sliding mode control design for finite-dimensional systems, governed by ordinary differential equations
- The wide range of applications are demonstrated to show the advantages of the sliding mode control methodology (e.g. for electric motors, manipulators, mobile robots)
- Overcome implementation difficulties, special attention will be paid to suppression of chattering caused by unmodeled dynamics

Course Topics:

- Examples of dynamic systems with sliding modes. Sliding modes in relay and variable structure systems
- Mathematical background: differential equations with discontinuous right-hand sides, regularization methods, equivalent control method, sliding mode existence conditions
- Design methods: decomposition, regular form of motion equations, eigenvalue placement and mean-square optimization in linear systems, control under uncertainty condition
- Chattering problem: systems with unmodeled dynamics, motion separation in singularly perturbed systems, sliding mode in systems with observers, harmonic cancellation
- Discrete-time sliding mode control: definitions, design methods, control in linear systems
- Control in distributed systems: motion equations, distributed control, modal control, point-wise control
- Control of electric motors and power converters: motion equations; speed, position, current and flux control; speed, acceleration, load torque and flux observers; DC/DC, DC/AC converters
- Control of manipulators: motion equations, position and speed control, lumped control of flexible longitudinal and rotational oscillations, control of mobile robots
- Motion equations: artificial potential field method for navigation and control, nonholonomic mobile robots

---

Designation:
Elective