PKU Globex Julmester®

Smart Materials and Adaptive Systems (3 Credits)

智能材料与适应性系统

Instructors	**Gregory WASHINGTON** (gnwashin@uci.edu) **Farzad AHMADKHANLOU** (farzad.a@uci.edu)	Dept. of Mechanical and Aerospace Engineering University of California Irvine, USA
Synopsis	Modeling and control of smart materials to include: piezoceramics, piezopolymers, shape memory alloys, electrorheological and magnetorheological fluids. Applications to real world systems will be emphasized.	
Offering	2018 Julmester (July Semester)	
Audience	Year 3 & 4 Undergraduate and Year 1 Graduate Students	
Classroom	Room TBA, Teaching Bldg. No. TBA, Peking University	
Schedule	Class: 8-11 AM, M-F, July 2–20, 2018	Total Contact Hours: 45
	Final Exam: 8-11 AM, Saturday, July 21, 2018	

Objectives

- Develop macromechanical models of smart materials and relate those models to equivalent electrical energy circuits.
- Model and understand the nonlinear effects that effect smart materials
- Utilize smart materials in actuators, sensors and controlled materials design
- Apply smart materials to practical engineering systems

Topics

Class Organization, Introduction and Overview of Smart Materials

- Mathematical preliminaries (notation)
- Matrix and tensor mathematics
- General constitutive modeling

Electrorheological Fluids and Magnetorheological Fluids

- What are ER/MR Fluids
- ER/MR Fluid Dashpot Dampers
- Newtonian shear flow, Bingham plastic shear flow, Rectangular Duct Analysis
- Design with ER/MR Fluids

Piezoelectric Materials

- What are piezoelectric materials
- PZT properties and material constants
- Piezoelectric films
- Nonlinear effects
- Hysteresis, creep, depoling
- Incorporating PZT into structural systems
- Electrostrictive materials (PMN)
- Design with piezoelectrics

Shape Memory Alloys

- What are shape memory alloys?
- Constitutive Models
- Tanaka Model, Liang and Rogers Model, Brinson Model
- Testing of SMA Wires, SMA applications
- Design with SMA

Project Overview	The project consists of a design and analysis of a system using smart materials. Each subsection will result in a mini-design project.
Text	Course Notes prepared by instructors

Grading

Homework	30%
Project	25%
Midterm	20%
Final	25%
Total	**100%**