Smart Materials and Adaptive Systems (3 Credits)
智能材料与适应性系统

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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	2014 Summer Semester
Audience	Year 3 & 4 Undergraduates and Year 1 Graduate Students
Classroom	Room xxx, Teaching Bldg. No. XX, Peking University
Schedule	Class: 8-11 AM, M-F, July 7–25, 2014; Final Exam: 8-11 AM, July 26, 2014

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 actuator, sensor and controlled materials design
- Apply smart materials to practical engineering systems

Syllabus

Class Organization, introduction and overview of Smart Materials
- Mathematical preliminaries (notation)
- Matrix and tensor mathematics
- General constitutive modeling

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

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

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 Shape Memory

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 the instructor

Grading

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