Compliant Mechanisms : Principles and Design

ABOUT THE COURSE:

This course introduces the concept and principles of compliant mechanisms and presents the design methods in detail. Various applications of compliant mechanisms in consumer products, microsystems, aerospace, automotive, and biomedical industries will be touched upon throughout the course. It is a comprehensive treatment of the growing field of compliant mechanisms starting from the classics and basics and ending with the state of the art.

COURSE OUTLINE :

Week 1

Overview of compliant mechanisms; spirit of compliant design; a glimpse of applications.

Mobility analysis of compliant mechanisms: Grübler's formula, Maxwell's rule, and rank of the compatibility matrix

Week 2

Modeling of flexures (flexible joints or elastic pairs)

Simulation of compliant mechanisms using finite element analysis

Week 3

Large-displacement analysis of cantilever beams: the elastica approach

Pseudo Rigid-Body (PRB) modeling

Week 4

Analysis using pseudo rigid-body models

Synthesis using pseudo rigid-body models

Week 5

Structural optimization approach to "design for deflection"

Topology optimization approach to compliant mechanism design

Week 6

Designing compliant mechanisms using continuum topology optimization

Design of distributed compliant mechanisms

Week 7

Spring-lever (SL) and spring-masslever (SML) models for compliant mechanisms

Selection and re-design using SL and SML models

Week 8

Non-dimensional analysis of compliant mechanisms

Kinetoelastic maps of compliant mechanisms

Week 9

Other methods of compliant mechanisms

Mechanical advantage analysis of compliant mechanisms

Week 10

Bistable compliant mechanisms

Static balancing of compliant mechanisms

Week 11

Compliant mechanisms and microsystems

Manufacturing and materials for compliant mechanisms

Week 12

Case-studies of compliant mechanisms: Part 1

Case-studies of compliant mechanisms: Part 2