OPTICAL MEMS IN COMMUNICATION AND SENSING:

Fabrication, design and scaling of optical microsystems

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Course Outline:

A. Introduction and Overview

1. Introduction to Optical MEMS - Opportunities and challenges
    a. MEMS fabrication technology applied to optics - Bulk, surface and high-aspect-ratio-etching micromachined structures in optics
    b. Actuation principles and materials
    c. Integration and packaging - Monolithic integration of electronics and MEMS, Hybrid integration, bonding, and self assembly, Silicon-optical bench technology
2. Scaling of Optical Devices
    a. Diffraction made simple - Gaussian Beam propagation
    b. Resolution of microscanners and Spatial Light Modulators (projection displays)
    c. Requirements on surface quality
3. Micromirror Arrays
4. Micromirrors fabricated on Silicon-on-insulator materials

B. Optical MEMS in Telecommunications

1. Fiber switch concepts and implementations
    a. 2x2 switch
    b. Matrix switch
    c. 3-D switch
2. Implementation Challenges
    a. Optical quality, large switches, reliability, speed, fiber alignment, packaging
3. Filters and gain equalizers
4. Dispersion Compensation
5. Network impact

C. Diffractive Optical Microsystems

1. Design and operation of Grating Light Modulators
    a. Displays
    b. Free-space communication

   c. Voltage Controlled Attenuators
   d. Displacement sensors
2. Diffractive filters
3. Tunable lasers
4. MEMS/electronic integration

D. Optics and Nano-Electro-Mechanical-Systems (NEMS)

1. Atomic Force Microscopy
2. Photonic Crystals
   a. Integrated optics
   b. Holey fiber
3. 2-D Photonic Crystals
   a. Mirrors and filters
   b. Sensors
   c. Photon Tunneling
4. MEMS surfaces and interfaces
5. Conclusions and Outlook