

# EE607: MICROELECTROMECHANICAL SYSTEMS (MEMS)

Technology methods and physical principles of MEMS including survey of current MEMS

- Instructor: Prof. Eun Sok Kim (eskim@usc.edu, PHE 602, 740-4697)
  - Office Hours: Wednesday and Friday 3:00-3:50
- Class Time and Place: Friday 9:00 – 11:50am
- Textbook: My lecture notes from <http://blackboard.usc.edu/>

The following books may be helpful on some specific topics of the course.

- Micromachined Transducers Sourcebook by Gregory Kovacs
- Fundamentals of Microfabrication by Marc Madou
- Introduction to Microelectromechanical Systems Engineering by Nadim Maluf
- Microsystem Design by Stephen Senturia
- RF MEMS Theory, Design and Technology by Gabriel Rebeiz
- Microsensors, MEMS and Smart Devices by Julian Gardner, et al.
- Foundations of MEMS by Chang Liu

# Solid State Sensor Actuator Workshop

**Institute of Electrical and Electronics  
Engineers (New York, N.Y.)**



## **Solid State Sensor Actuator Workshop:**

Solid-State Sensor and Actuator Workshop, 1988. Technical Digest., IEEE. ,1988      **Solid-State Sensor and Actuator Workshop, 1990. 4th Technical Digest., IEEE. ,1990**      **Solid-state Sensor and Actuator Workshop ,1996**  
Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 3-6, 1996 ,1996      IEEE  
Solid-State Sensor and Actuator Workshop IEEE Electron Devices Society,1988      **IEEE Solid-State Sensor and Actuator Workshop ,1992-01-01**      **3rd Ieee Solid State Sensor and Actuator Workshop ,1988**      *MEMS Vibratory Gyroscopes* Cenk Acar,Andrei Shkel,2008-12-16 MEMS Vibratory Gyroscopes provides a solid foundation in the theory and fundamental operational principles of micromachined vibratory rate gyroscopes and introduces structural designs that provide inherent robustness against structural and environmental variations In the first part the dynamics of the vibratory gyroscope sensing element is developed common micro fabrication processes and methods commonly used in inertial sensor production are summarized design of mechanical structures for both linear and torsional gyroscopes are presented and electrical actuation and detection methods are discussed along with details on experimental characterization of MEMS gyroscopes In the second part design concepts that improve robustness of the micromachined sensing element are introduced supported by constructive computational examples and experimental results illustrating the material      **Solid State Sensor and Actuator ,1988**      **Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 2-6, 2002 ,2002**      *IEEE Solid-State Sensor and Actuator Workshop* Institute of Electrical and Electronics Engineers (New York, N.Y.),1988      **Solid-state Sensor and Actuator Workshop ,1996**      **Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 13-16, 1994 ,1994**      **Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 4-8, 2000** Transducers Research Foundation, Inc,2000      Sensors, Mechanical Sensors Wolfgang Göpel,Joachim Hesse,J. N. Zemel,2008-11-20 Sensors is the first self contained series to deal with the whole area of sensors It describes general aspects technical and physical fundamentals construction function applications and developments of the various types of sensors This volume contains the physical and technical fundamentals of mechanical sensors and contains and assesses the various types of sensors for particular applications Of interest to engineers physicists chemists and others involved in sensor technology      From MEMS to Bio-MEMS and Bio-NEMS Marc J. Madou,2011-06-13 From MEMS to Bio MEMS and Bio NEMS Manufacturing Techniques and Applications details manufacturing techniques applicable to bionanotechnology After reviewing MEMS techniques materials and modeling the author covers nanofabrication genetically engineered proteins artificial cells nanochemistry and self assembly He also discusses scaling laws in MEMS and NEMS actuators fluidics and power and brains in miniature devices He concludes with coverage of various MEMS and NEMS applications Fully illustrated in color the text contains end of chapter problems worked examples extensive references for further reading and an extensive glossary of terms Details the Nanotechnology Biology and

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**Micromixers** Nam-Trung Nguyen, 2008-05-07 A wide range of applications in chemistry and biochemistry are driving the rapid development of microfluidics This book focuses its attention on an important subtopic of microfluidics mixing in microscale It provides the fundamentals of transport effects in microscale including molecular diffusion convection and chaotic advection The science and technology of microfluidics cover a wide spectrum and the science of mixing in microscale has evolved from reports on fabricated devices to an extensive collection of established knowledge The focal point of Micromixers Fundamentals Design and Fabrication is the current applicable knowledge and practical issues in designing fabricating and characterizing micromixers in the chemical and biochemical industries Based on scaling law it recommends practical micromixer designs utilizing the advantages of the microscale effects The book is intended for practicing engineers and for upper level undergraduate and graduate level students Provides the basic terminology and fundamental physics of transport effects used for designing micromixers Highlights the challenges and advantages of miniaturization in mixing Outlines currently available microtechnologies for fabricating micromixers Discusses current applications including lab on a chip for chemical biochemical analysis and chemical production Defines concepts such as electrohydrodynamic dielectrophoretic electrokinetic magneto hydrodynamic acoustic and thermal effects and their implementation in micromixers

**Manufacturing Techniques for Microfabrication and Nanotechnology** Marc J. Madou, 2011-06-13 Designed for science and engineering students this text focuses on emerging trends in processes for fabricating MEMS and NEMS devices The book reviews different forms of lithography subtractive material removal processes and additive technologies Both top down and bottom up fabrication processes are exhaustively covered and the merits of the different approaches are compared Students can use this color volume as a guide to help establish the appropriate fabrication technique for any type of micro or nano machine

**The MEMS Handbook** Mohamed Gad-el-Hak, 2001-09-27 The revolution is well underway Our understanding and utilization of microelectromechanical systems MEMS are growing at an

explosive rate with a worldwide market approaching billions of dollars In time microdevices will fill the niches of our lives as pervasively as electronics do right now But if these miniature devices are to fulfill their mammoth potential today s engineers need a thorough grounding in the underlying physics modeling techniques fabrication methods and materials of MEMS The MEMS Handbook delivers all of this and more Its team of authors unsurpassed in their experience and standing in the scientific community explore various aspects of MEMS their design fabrication and applications as well as the physical modeling of their operations Designed for maximum readability without compromising rigor it provides a current and essential overview of this fledgling discipline      MEMS and MOEMS Technology and Applications P. Rai-Choudhury,2000

The silicon age that led the computer revolution has significantly changed the world The next 30 years will see the incorporation of new types of functionality onto the chip structures that will enable the chip to reason to sense to act and to communicate Micromachining technologies offer a wide range of possibilities for active and passive devices Recent developments have produced sensors actuators and optical systems Many of these technologies are based on surface micromachining which has evolved from silicon integrated circuit technology This book is written by experts in the field It contains useful details in design and processing and can be utilized as a reference book or as a textbook

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### **Table of Contents Solid State Sensor Actuator Workshop**

1. Understanding the eBook Solid State Sensor Actuator Workshop
  - The Rise of Digital Reading Solid State Sensor Actuator Workshop
  - Advantages of eBooks Over Traditional Books
2. Identifying Solid State Sensor Actuator Workshop
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Solid State Sensor Actuator Workshop
  - User-Friendly Interface
4. Exploring eBook Recommendations from Solid State Sensor Actuator Workshop
  - Personalized Recommendations
  - Solid State Sensor Actuator Workshop User Reviews and Ratings
  - Solid State Sensor Actuator Workshop and Bestseller Lists

5. Accessing Solid State Sensor Actuator Workshop Free and Paid eBooks
  - Solid State Sensor Actuator Workshop Public Domain eBooks
  - Solid State Sensor Actuator Workshop eBook Subscription Services
  - Solid State Sensor Actuator Workshop Budget-Friendly Options
6. Navigating Solid State Sensor Actuator Workshop eBook Formats
  - ePub, PDF, MOBI, and More
  - Solid State Sensor Actuator Workshop Compatibility with Devices
  - Solid State Sensor Actuator Workshop Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Solid State Sensor Actuator Workshop
  - Highlighting and Note-Taking Solid State Sensor Actuator Workshop
  - Interactive Elements Solid State Sensor Actuator Workshop
8. Staying Engaged with Solid State Sensor Actuator Workshop
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Solid State Sensor Actuator Workshop
9. Balancing eBooks and Physical Books Solid State Sensor Actuator Workshop
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Solid State Sensor Actuator Workshop
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Solid State Sensor Actuator Workshop
  - Setting Reading Goals Solid State Sensor Actuator Workshop
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Solid State Sensor Actuator Workshop
  - Fact-Checking eBook Content of Solid State Sensor Actuator Workshop
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

#### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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