การพัฒนาระบบควบคุมต้นแบบโดยอิงเทคโนโลยีระบบเครื่องกลไฟฟ้าจุลภาค
(Development of generic smart MEMS based control system)

Researcher

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Introduction

MEMS, a new sector in the semiconductor industry which promise to make many new applications possible. Although MEMS remains an undeveloped technology, MEMS device usage has increased rapidly. Despite this growth, very few resources for design and manufacturing of these devices exist. AIT MEMS Group, focusing on this future demand, aims to research the development of generic smart MEMS with embedded control system as a complete microsystem. The research is intended to match the current and future market for MEMS-based devices such as a car crash airbag acceleration sensor, microactuator for recording head of hard disk drives and RF MEMS components.

Objectives

- Optimal Design and Fabrication of Electrostatic comb drive Microactuator for Computer Disk Drive Dual-Stage Servo Systems
- Design of MEMS Levitation motion Gimbaled Electrostatic Combdrive Microactuator.
- Control Roll and Pitch Angles of Slider., Air Bearing effect on Microactuator & its Behavior.
- Active Flying Height control by Optimized Microactuator
- Design and optimisation each component of the 900 MHz transceiver.
- Design and possibly fabricate a CMOS module for the amplifier circuits.
- Optimal Design and Fabrication of the Microaccelarometer.

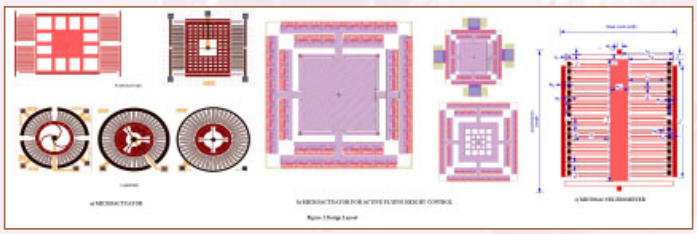
Method

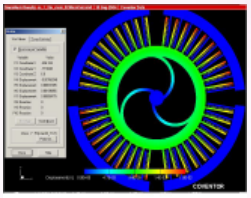
In this research started with design of an electrostatic actuator and an accelerometer sensor. We are modeling and designing both devices now. Two designs of the electrostatic microactuator have been sent for fabrication using the POLYMUMS technique.

- Design Layout (Figure 1)
- Simulation (Conventor ware) (Figure 2)
- Fabrication Process (MUMPS)
- Verify Structure (SEM) (Figure 4)

Results

1. Designs and Fabrication of Electrostatic comb drive Microactuator (Figure 1 a)
   - Transverse actuator Design
     - The model shows maximum displacement of at voltage control range of 30 to 48 volts.
     - This design is shown to be accurately modeled as a very small hysteresis loop. (Figure 3)
     - The resonant frequency is slightly lower than expected.
   - Rotational actuator design
     - Completed design and fabrication (Figure 4)
     - The model shows small movement at 30 volt.
2. Designs of MEMS Levitation motion Gimbaled Electrostatic Comb drive Microactuator. (Figure 1 b)
   - The model shows small levitate. (Figure 5)
3. Designs and Fabrication of the Microaccelerometer (Figure 1 c)
   - Microaccelerometer Structure complete (Figure 4)
   - Simulation (Conventor ware)





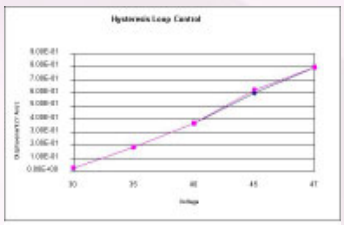


Figure 3 Displacement graph of hysteresis

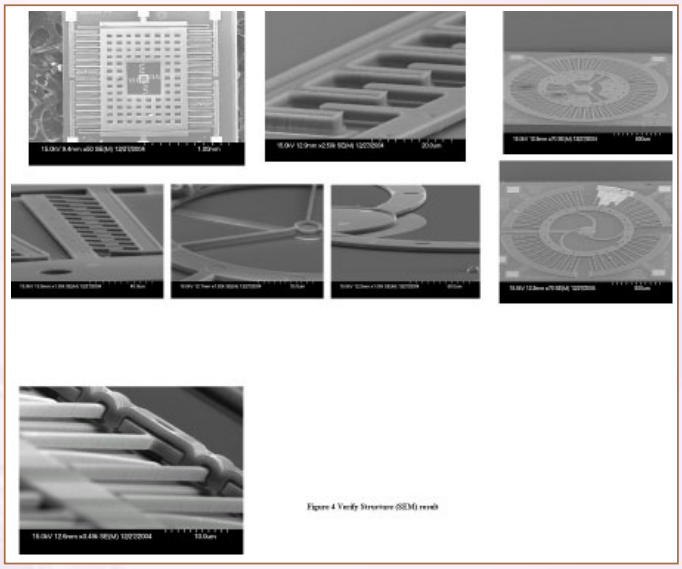


Figure 4 Verify Structure (SEM) result

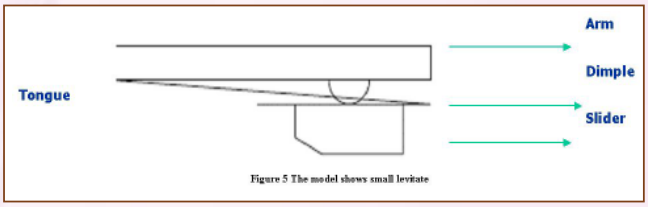


Figure 5 The model shows small levitate

Conclusion

- MEMS is a promising technology fusing all existing technologies together; especially microelectronics, mechanical system design, and control.
- Evidence has shown extremely high potential of MEMS for various applications.
- However, MEMS research situation in Thailand is far below compare with other countries.
- This project will be taken as an endeavor for MEMS development and it future applicability for Thailand's industry.

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