

MEMS research challenges: A different perspective

The world of MEMS has evolved over the last decade and MEMS based sensors have wide spread applications. It has applications in the area of defense, consumer products, structural health monitoring amongst others. In this talk, the challenges in MEMS research in tier II institutes will be discussed and dealt with.

The research in MEMS was accelerated with the NPMASS programme initiative. Under this programme three MEMS community chips were fabricated. In the first community chip eight academic institutions participated, in the second 6 institutions and the last community chip had again 8 institutions participating. While the first community chip had only thermal actuator as the device from all institutions, the second had a variety of devices; like microheater, RF switch, accelerometer, varactor, micromotor etc. The third community chip had devices like energy harvester, RF switch, bidirectional actuator, directional microphone etc. These experiments with the community chip which was coordinated by the team at Nitte Meenakshi Institute of Technology (NMIT) proved to the country that even tier II institutes can play a significant role in research and development in the country in MEMS area.

The Thermal actuator designed, fabricated and characterized as a part of the first community chip under SOIMUMPS process showed promising results wherein the simulated results were matching with the characterization results. In the second community chip which was fabricated in PolyMUMPS process. The team from NMIT fabricated a varactor and a micromotor which did not yield any electrical characterization result. Only mechanical movements were visible.

In the third community chip which was again done under the SOIMUMPS process, a directional microphone was fabricated by our institute. This device was characterized at wafer level and also post packaging. The design of the microphone is inspired by the structure of the hearing organ of the parasitoid *Ormia Ochracea*. The device gave a sensitivity of 1.5 pF/ Pa in comparison to 0.1pF/Pa reported earlier for similar structure. The talk will give details on design aspects of the microphone and also interface to electronic circuitry.

Other than the community chip option, the team at NMIT has also fabricated an accelerometer under the INUP programme at CeNSE IISc. This device too has shown promising results where many structures were simulated and also fabricated. The wafer level characterization results are matching with the simulation results.

To conclude, it can be seen from the work carried out at NMIT, even a tier II institute can carry out good research work in this area provided there is good networking, good team work, motivation and opportunity to fabricate devices. IISc, IIT-B, SCL, Ceeri Pilani etc. have the facility to fabricate. Post NPMASS programme, it is now essential that all institutes join together and form clusters and continue to have many such community chips wherein the cost to fabricate can be shared by participating institutes. It is now in the hands of every institute to come forward and network to make this a reality.

Biodata

Education

Ph.D in Electronics from University of Mysore

Ph.D Title: “Design, Implementation and Characterization of a Biologically inspired MEMS Directional Microphone”, 2017

M.Tech Program in VLSI Design and Embedded System, Nitte Meenakshi Institute of Technology, Bangalore, Visveswariah Technological University. (First Class with Distinction), 2009

Bachelor of Engineering in Electronics and Communications

Vidya Vikas Institute of Engineering and Technology, University of Mysore, 2001,
(First Class with Distinction).

Skills

- MEMS TOOL: Coventware Turbo, COMSOL, LEDIT
- VLSI Tool: Tanner tool, HSpice, Synopsys, Cadence

Professional Training

Under taken the Hands on training on Fabrication in March 2012 under INUP at CeNSE,IISc.
INUP has accepted the Project Proposal of Fabrication of MEMS Microphone.

Current Area of Research

MEMS Acoustic sensor, Device Fabrication, Analog VLSI Design.

Research Experience

- Coordinated along with Dr. S.L.Pinjare, the NPMASS community chip under PolyMUMPs process in the year 2012- 2013 and under SOIMUMPS process 2013- 2014.
- **Patent application number:** Patent application number: 2785/CHE/2013 “Method for hardware implementation of Random Perturbation Algorithm”.
- **Patent application number:** 3620/CHE/2015 “Biologically Inspired MEMS Directional Microphone with Improved Sensitivity”
- **Fabricated Devices:** MEMS Thermal Actuator, MEMS Varactor, MEMS Micromotor, MEMS Directional Microphone.
- **Chairman ISSS Education Programme for the country**

Sponsored / Consultancy Projects

1. Design, simulation and modeling of MEMS microphone array and signal conditioning electronics
Sponsoring Agency: DRDO – SITAR
Amount: Rs. 7 Lakhs
Duration: 1 Year
Sanction Year: 2015
Status: Completed
2. Design, Fabrication and characterization of MEMS Microphone with signal conditioning circuitry for Hearing Aid Application
Sponsoring Agency: DST- TIDE
Amount: Rs. 46,72,581
Duration: 3 Year
Sanction Year: 2016
Status: Ongoing

Talks Delivered

1. Andra University: 8th Dec 2015: Title : **Development of MEMS Community Chip**
2. MSRIT: 24th Dec 2015: Title: **Biologically inspired MEMS Microphone**
3. VNRVJIT, Hyderabad: Feb 8th to 13th 2016: **Introduction to MEMS**
4. BEC, Bagalkot: 20th 22nd Oct 2016: Title: **Development and Application of MEMS based sensor & MEMS Community chip**
5. NMAMIT, Nitte: 23/01/2017: Title : **ISSS ACTIVITIES AND INTRODUCTION TO MEMS**
6. VIDYA VIKAS INSTITUTE OF TECHNOLOGY: 4TH NOV 2016: TITLE: **Development and Application of MEMS based sensor**
7. FTD INFOCOM: Bangalore 15th Feb 2017: **MEMS Design challenges in Educational Institutions**
8. PSG Coimbatore: Coimbatore 9th and 10th March 2017: **MEMS Devices and Interface with Electronic Circuitry**
9. VIDYA VIKAS INSTITUTE OF TECHNOLOGY: 10TH APRIL 2017: **ISSS ACTIVITIES AND MEMS DEVICES APPLICATIONS**

Professional Experience

Associate Professor - Electronics and Communication Department.

Sept '04- till date

Nitte Meenakshi Institute of Technology

Have handled subjects for UG (B.E) like VLSI, MEMS, ASIC Design among others.

At the Post Graduate level have handled subjects like Design of VLSI Systems, CMOS VLSI Design, Advances in VLSI design and MEMS

Projects Guided

Guided several UG and PG projects on analog implementation of ANN, Analog VLSI and MEMS based acoustic sensor

Coordinator- Center for Nanomaterials and MEMS, NMIT

Jan 2014 – till date

Center for Nanomaterials and MEMS was established at NMIT in the year 2014. The center has coordinated the fabrication of two NPMASS sponsored community chip till date.

The main objective of the center is to establish as the level two training center (after IISc) for students, research scholars and faculty members to carry out research in the area of Nanomaterials, thin films and MEMS devices.

Publications

Several National and International conference and journal papers including conferences abroad, and IEEE journal paper.