

Sagnik Pal

Biophotonics and Microsystems Lab,
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Objective:

Research position geared towards the ideation, design, reliability and fabrication of novel MEMS.

Education:

- PhD Dept. of Electrical and Computer Engineering,
University of Florida, Gainesville, August 2011.
- GPA: 3.95/4.0
 - Dissertation: Modeling and Reliability of Electrothermal Micromirrors
 - Advisor: Dr. Huikai Xie
- M.Tech
(Hons.) Microwave & Photonics,
Dept. of Electrical Engineering,
Indian Institute of Technology, Kanpur, 2006.
- Ranked 1st with a CPI of 10.00/10.00.
 - Academic Excellence Award, 2006.
 - Dissertation: Theory and Applications of Optically Actuated MEMS Structures
 - Advisor: Dr. Anjan K. Ghosh
- B.Tech
(Hons.) Dept. of Electrical Engineering,
Indian Institute of Technology, Kharagpur, 2004.
- CGPA: 8.14/10.00
 - Thesis: Electric Machine Analysis Using Field Theory
 - Advisor: Dr. T. K. Bhattacharya

Employment:

- 10/2011-
Present Research Associate, Biophotonics and Microsystems Lab, Univ. of Florida.
- Designed in-plane transducers for miniature interferometer based bioimaging and cytometry.
- 08/2006-
09/2011 Research Assistant, Biophotonics and Microsystems Lab, Univ. of Florida.
- Designed and fabricated novel micromirrors with low center-shift, high fill-factor, and improved voltage and power requirements. The new designs enable miniaturization of bio-imaging endoscopes.
 - Proposed and implemented novel fabrication process for robust, fast electrothermal micromirrors. The improved robustness enables real-world bio-imaging applications.
 - Proposed, analyzed and fabricated novel MEMS transducers known as curved multimorphs.
 - Proposed novel in-plane MEMS transducers that produce order of magnitude greater displacement compared to existing designs.
 - Optimized mirror design that resulted in ten-fold improvement in

- scan-range. The mirrors were used in dental imaging probes.
- Developed comprehensive electrothermomechanical device models.
- Supervised experiments on device reliability and control by two graduate students.
- Delivered lectures on thermal modeling for a course on “Principles of MEMS Transducers,” Instructor: Dr. Huikai Xie, 2009.
- Please visit <http://sagnik.yolasite.com/projects.php> for more details.

2004-06

Teaching Assistant, Indian Institute of Technology, Kanpur.

- Organized graduate-level lab sessions for a course on “Finite Element Method for Electric & Magnetic Fields,” Instructor: Dr. Nandini Gupta, IIT Kanpur, 2006.
- Evaluated student performance and prepared teaching material for a course on “Microelectromechanical Systems,” Instructor: Dr. Anjan K. Ghosh, IIT Kanpur, 2005.
- Prepared e-learning study material for National Program on Technology Enhanced Learning, Supervisor: Dr. Anjan K. Ghosh, IIT Kanpur, 2004.

Fabrication and Related Skills: 4+ years clean-room experience

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| Processing | Hands-on experience with RIE, DRIE, wet-etching and lift-off; thin-film sputtering, PECVD and e-beam deposition; lithography |
| Metrology | Profilometry, Ellipsometry, SEM |
| Miscellaneous | Dicing saw, Ball bonder |

Software Skills:

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| Simulation | COMSOL, Ansys, IntelliSuite, Coventorware, SPICE |
| Computing | Matlab, Mathematica |
| Layout | Cadence, LEdit |
| Programming | C, C++, Java, SQL |
| Miscellaneous | Labview, HTML, familiarity with Linux and Windows |

Languages:

English, Hindi, Bengali, Sanskrit

Patents:

S. Pal, S. R. Samuelson and H. Xie, “Multimorph based MEMS transducers that produce large in-plane displacement,” UF#13875, submitted to Office of Technology and Licensing, University of Florida, July 2011.

S. Pal, H. Xie and K. Zawoy, “MEMS designs based on curved multimorph microactuators that generate combined bending and twisting,” UF #13407, patent pending, International Application No. PCT/US2011/038786; filed 1st June 2011.

S. Pal and H. Xie, “Fabrication of robust electrothermal MEMS with fast thermal response,” UF #13359, patent pending, Serial No. 61/422,320; filed 13th December 2010.

Publications: 8 journal papers and 18 conference papers

Novel Designs

S. Pal, S. R. Samuelson, H. Xie, "Novel Mechanisms for Millimeter Range Piston Actuation of Vertical Micromirrors and Microlenses," to be presented at the Int. Conf. on Optical MEMS and Nanophotonics 2012, Banff, August 6-9, 2012.

L. Liu, **S. Pal**, and H. Xie, "MEMS mirrors based on a curved concentric electrothermal actuator," *Sensors and Actuators A: Physical* (In Press).

S. Pal, H. Xie, "A curved multimorph based electrothermal micromirror with large scan range and low drive voltage," *Sensors & Actuators: A Physical*, Vol. 170, pp. 156-163, 2011.

S. Pal, H. Xie, "Design and fabrication of 2D fast electrothermal micromirrors with large scan range and small center shift," presented at Transducers 2011, abstract no. 10-125, Beijing, June 5-9, 2011, pp. 2550-2553.

L. Liu, **S. Pal**, H. Xie, "MEMS mirrors based on curved concentric electrothermal actuators with very small lateral shift and tilt," presented at Transducers 2011, abstract no. 10-112, Beijing, June 5-9, 2011, pp. 2522-2525.

Modeling and Analysis

S. Pal, H. Xie, "Analysis and fabrication of curved multimorph transducers that undergo bending and twisting," *IEEE/ASME Journal of Microelectromechanical Systems*, In Press (accepted), 2012.

S. Pal, H. Xie, "Analysis, simulation and fabrication of curved multimorphs that undergo bending and twisting," to be presented at IEEE Sensors 2011; paper no. 1702; Limerick, Ireland; October 28-31, 2011, pp. 667-670.

S. Pal, H. Xie, "Distributed and lumped element models for a bimorph-actuated micromirror," *Journal of Micromechanics and Microengineering*, Vol. 20, p. 045020, 2010.

S. Pal, H. Xie, "Analysis and simulation of curved bimorph microactuators," presented at Microtech Conference and Expo; Anaheim, CA; June 21-24, 2010, pp. 685-688.

S. Pal, H. Xie, "Dynamic compact thermal model of an electrothermal micromirror based on transmission line theory," presented at Microtech Conference and Expo; Anaheim, CA; June 21-24, 2010, pp. 589-592.

S. Pal, H. Xie, "A parametric dynamic compact thermal model of an electrothermally actuated micromirror," *Journal of Micromechanics and Microengineering*, Vol. 19, 065007, 2009.

K. Jia, **S. Pal**, H. Xie, "An electrothermal tip-tilt-piston micromirror based on folded dual S-shaped bimorphs," *Journal of Microelectromechanical Systems*, vol. 18, pp. 1004-1015, 2009.

K. Jia, **S. Pal**, H. Xie, "An agile tip-tilt-piston micromirror with large aperture, large scanning range and low driving voltage," presented at Hilton Head Conference, June 2008, pp. 284-287.

S. Pal, K. Jia, S. Maley, H. Xie, "Reduced order thermal modeling of a one-dimensional electrothermally actuated micromirror device," presented at SPIE Photonics West Conference; San Jose, CA; January 2008, vol. 6885, pp. 68850B-11.

A. K. Ghosh, **S. Pal**, "Optimal actuation of a MEMS cantilever by a laser beam," presented at SPIE Optics East; paper no. 6374A-20; Boston, MA; October 2006, p. 63740O.

S. Pal, A. K. Ghosh, "Optimal actuation of micro-cantilevers by laser radiation pressure," *Electronics Letters*, vol.42, no.10, pp. 580-581, 2006.

S. Pal, T. K. Bhattacharyya, "Radial air gap flux of DC machines with Ansys 7.0," presented at Ansys users' conference, New Delhi, 2004.

Reliability

S. Pal, H. Xie, "A process for fabricating robust electrothermal micromirrors with customizable thermal response time and power consumption," IEEE Optical MEMS and Nanophotonics 2011, paper no. 10028928, Istanbul, pp. 157-158, August 8-11, 2011.

S. Pal, H. Xie, "Repeatability study of an electrothermally actuated micromirror," presented at IEEE International Reliability Physics Symposium, pp.549-556, April 2009.

Control

S. Pal, H. Xie, "Pre-shaped open loop drive of electrothermal micromirror by continuous and pulse width modulated waveforms," IEEE Journal of Quantum Electronics, vol. 46, issue 9, pp.1254-1260, 2010.

S. Pal, H. Xie, "Maximization of constant velocity scan range of electrothermally-actuated micromirror by pulse width modulated drive," Proc. of the IEEE/LEOS International Conference on Optical MEMS & Nanophotonics; Clearwater Beach, FL; August 17-20, 2009, pp. 55-56.

S. Pal, K. Jia, H. Xie, "An electrothermal micromirror with high linear scanning efficiency," presented at LEOS'07; paper no. ThAA4; Lake Buena Vista, FL; Oct. 21-25, 2007, pp. 914-915.

Applications

K. Jia, L. Wu, **S. Pal**, D. Hamilton, H. Xie, "Dental optical coherence tomography employing miniaturized MEMS-based imaging probe," Proc. of the IEEE/LEOS International Conference on Optical MEMS & Nanophotonics; Clearwater Beach, FL; August 17-20, 2009, pp. 1-2.

K. Jia, **S. Pal**, H. Xie, "High-fill-factor, tip-tilt-piston micromirror array with hidden bimorph actuators and surface mounting capability," Proc. of the IEEE/LEOS International Conference on Optical MEMS & Nanophotonics; Clearwater Beach, FL; August 17-20, 2009.

A. K. Ghosh, **S. Pal**, "A MEMS device for measuring laser power and spot-size," Quantum Sensing and Nanophotonic Devices VI: Proceedings of SPIE, Vol. 7222, January 2009.

X. Feng, A. Jain, **S. Pal**, L. Xiao, T. Nishida, H. Xie, "LVD micromirror for rapid reference scanning in optical coherence tomography," MEMS/MOEMS Components and Their Applications IV, vol. 6464, no. 1: SPIE, pp. 64640M; Proc. of the Photonics West Conference; paper 6464-22; San Jose, CA; January 2007.

Peer Review Work:

- Journal of Micromechanics and Microengineering
- Sensors and Actuators: A Physical

Administrative Positions:

2009-Present Lab Safety Committee Member, Interdisciplinary Microsystems Group, University of Florida.

- Enforced safety procedures
- Trained lab personnel
- Ensured smooth annual audits

2007-09 Web administrator, Biophotonics and Microsystems Lab, University of Florida.

- Created website
- Ensured that website is up-to-date, aesthetic and error free

- 2004-05 Coordinator, Microwave & Photonics Research Group, Indian Institute of Technology, Kanpur.
- Organized lectures, seminars and discussions
 - Coordinated information kiosk for prospective students

Academic Honors:

- Inducted into IEEE-HKN (Eta Kappa Nu) Honor Society, 2008.
- Academic Excellence Award, IIT Kanpur, 2006.
- Obtained 99.17 percentile in all-India Graduate Aptitude Test in Engineering, 2004.
- Ranked 638 in IIT-Joint Entrance Exam, 2000.
- National Standard Examination in Physics, Certificate of Merit 2000.
- National Standard Examination in Chemistry, Certificate of Merit 2000.
- National Certificates of Merit in Mathematics and English, 1998.
- Silver Medal, Talent Search Test in Mathematics, 1996.

Selected Graduate-Level Courses:

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| Micro/nano technology | Advanced Microsystems Technology, Microelectronic Fabrication Technologies, Quantum Mechanics for Nanodevices |
| Electromagnetics | Advanced Electromagnetics, Fiber Optics, Microwave Measurements and Design, Finite Element Method for Electric and Magnetic Fields |
| Control Theory | Modern Control Theory, State Variable Methods |
| Miscellaneous | Introduction to Biophotonics, Failure of Materials in Mechanical Design |

Workshops:

- “COMSOL 4.1 hands-on workshop,” FL, February 24, 2011.
- “SBIR/STTR cost proposal workshop,” FL, May 7, 2010.
- “Time management,” Graduate Professional Development Workshop, FL, February 2008.

Industrial Training:

- 05/2003- Wire & Wire Ropes Division, Usha Martin, Ranchi, India.
06/2003
- Programmed drives and microcontrollers
 - Conducted experiments on electric machines

Additional Accomplishments:

- Ranked 5th in marathon, Josh'05, IIT Kanpur, 2005.
- Certificate of Proficiency, 3rd kyu, Shotokan Karate-Do Federation, 1997.