

Tufts University
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Primary Fields of Competence

Microelectromechanical Systems (MEMS) fabrication, modeling, and testing. Electromechanical systems. Acoustics, vibrations, dynamics and controls. Finite element methods. Mechanical measurements and experimental methods. Electronics for measurement.

Education

University of Michigan, Ann Arbor PhD, Mechanical Engineering 2005
Dissertation: “*Biomimetic Trapped Fluid Microsystems for Acoustic Sensing*” Micromechanical systems (MEMS), dynamics, acoustics, and cochlear mechanics. Advisor: Prof. Karl Grosh.

Massachusetts Institute of Technology MS, Mechanical Engineering 1999
Master’s Thesis: “*Effects of Impact and Vibration on the Performance of a Micromachined Tuning Fork Gyroscope*”. conducted at C. S. Draper Labs, Cambridge, MA. Advisors: Dr. Marc Weinberg, Prof. Zaichun Feng.

Massachusetts Institute of Technology BS, Mechanical Engineering 1999
Minor in mathematics. Concentration in music.

Professional Experience

Assistant Professor, Mechanical Engineering, Tufts University, Medford, MA. *September 2005-Present*
Teaching and research in the areas of microsystems, dynamics, acoustics, vibration, and controls. Research interests include micro- and nano- fabrication, acoustic sensors, shear sensors, modeling of microsystems, planarization technology, robotics, biomimetic design, and cochlear mechanics.

Graduate Student Research Assistant, Univ. of Michigan, Ann Arbor, MI. *Jan. 2001-August 2005*
Vibrations and Acoustics Lab and Solid State Electronics Lab. Design, microfabrication, testing of silicon and glass microsystems. Biomimetic design based on cochlear mechanics. Fluid-structure modeling and testing at the microscale including finite element work.

MEMS Test Engineer, Charles Stark Draper Laboratories, Cambridge MA. *June 1999-July 2000*
Performance and environmental testing of MEMS gyroscopes. Development of test capabilities.

Draper Fellow, Charles Stark Draper Laboratories, Cambridge MA. *Jan. 1998-May 1999*
Masters thesis on modeling and testing of MEMS gyroscope response to vibration and shock.

Teaching Experience

Microelectromechanical Systems (Graduate Level), Tufts Univ. *Spring 2007, Fall 2009*

Systems Dynamics and Controls (Senior Undergrad), Tufts Univ. *3 times, 2006-2008*

Dynamics and Vibrations (Junior Undergrad), Tufts Univ. *Spring 2006*

Acoustics (Graduate Level), Tufts Univ. *Fall 2005, Spring 2008*

Journal Publications

Doody, C., Lemmerhirt, D., Cheng, X., Collin, R., White, R. D. “*Modeling and Characterization of CMOS-Fabricated Capacitive Micromachined Ultrasonic Transducers*”, submitted to the Journal of Microelectromechanical Systems, September 21, 2009 (under review).

Saunders, F., Golden, E., White R. D., and Rife, J. “*Experimental Verification of Soft-Robot Gaits Evolved Using a Lumped Dynamic Model*”, submitted to Robotica, August 7, 2009 (under review).

Amsden, J., Domachuk, P., Gopinath, A., White, R.D., Dal Negro, L., Kaplan, D. and Omenetto, F. “*Rapid Nanoimprinting of Silk Fibroin Films for Biophotonic Applications*”, Advanced Materials, accepted manuscript, article in press.

Vlahakis, J., Rogers, C., Manno, V., White, R., Moinpur, M., Hooper, D., and Anjur, S., “*Synchronous, In Situ Measurements in Chemical Mechanical Planarization*”, Journal of the Electrochemical Society, **156** (10), pp. 794-802, 2009.

Mueller, N., Rogers, C. Manno, V., White, R. and Moinpour, M., “*In-Situ Investigation of Slurry Flow Fields during CMP*”, Journal of the Electrochemical Society, **156** (12), pp. H908-H912, 2009.

Cheng, L., White, R. D., and Grosh, K. “*Three Dimensional Viscous Finite Element Formulation For Acoustic Fluid Structure Interaction*” Computer Methods in Applied Mechanics and Engineering, **197** pp. 4160–4172, 2008.

Galbraith, C. , White, R. D., Cheng, L., Grosh, K. and Rebeiz, G. M. “*Cochlea-Based RF Channelizing Filters*”, IEEE Transactions on Circuits and Systems I: Regular Papers, **55** (4), pp. 969-979, 2008.

Liu, S. and White, R. D. “*Orthotropic material properties of the gerbil basilar membrane*”, Journal of the Acoustical Society of America, **123** (4), pp. 2160-2171, 2008.

Gray, C., White, R. D., Manno, V. P., and Rogers, C. B. “*Simulated Effects of Measurement Noise on Contact Measurements between Rough and Smooth Surfaces*”, Tribology Letters, **29** (3), pp. 185-192, 2008.

White, R. D., Cheng, L., and Grosh, K. “*Microfabrication of Coupled Fluid-Structure Systems with Applications in Acoustic Sensing*”, Sensors and Actuators A: Physical, **141** (2), pp. 288-298, 2008.

Martin, M. J., White, R. D., Kurabayashi, K., and Boyd, I. D., “*Fabrication of beam structures with micro-scale cross-sections and meso-scale spans*,” Journal of Micromechanics and Microengineering, **17** (12), pp. 2516-2521, 2007.

White, R. D., and Grosh, K. “*Microengineered hydromechanical cochlear model*” Proceedings of the National Academy of Sciences **102** (5), 2005, pp. 1296-1301.

Patents

R. White and J. Krause, U.S. Patent: “*MEMS Microphone Array on a Chip*”, Serial Number PCT/US2009/045289, filed May 27, 2009. Claims the benefit of U.S. provisional application Serial Number 61/056,291 filed May 27, 2008.

R. White, A. Mueller, C. Rogers, V. Manno, D. Gauthier, and H. Stone U.S. Patent: “*Shear Sensors and the Uses Thereof*”, Serial Number PCT/US2009/039415 filed April 3, 2009. Claims the benefit of U.S. provisional application Serial No. 61/042,132 filed April 3, 2008.

R. White and K. Grosh, U.S. Patent Pending: “*Trapped Fluid Microsystems For Acoustic Sensing*”, Serial No. 11/656,849 filed January 23, 2007. Claims the benefit of U.S. provisional application Serial No. 60/761,166 filed January 23, 2006.

Peer-reviewed Conference Publications

Krause, J., White, R., Moeller, M., and deJong R., “*MEMS Pressure Sensor Array for Aeroacoustic Analysis of the Turbulent Boundary Layer*” in the Proceedings of the AIAA, AIAA Infotech, Seattle, WA, April 6-9, 2009.

Thompson, J., Tepolt, G. Racz, L., Rogers, C. B., Manno, V. P., and White, R. D. “*A Method for Die Thickness Reduction to sub-35 μm* ” in the Proceedings of the Materials Research Society, MRS Fall Meeting, December 2008.

White, R., Vlahakis, J., Gray, C., Manno, V., Braun, N., Gauthier, D., Mueller, A., Rogers, C. and Moinpour, M. “*In Situ Characterization of the Mechanical Aspects of CMP*” in the Proceedings of the International Conference on Planarization/CMP Technology 2008, Hsinchu, Taiwan, November 10-12, 2008.

C.B. Doody, R. D. White, J.S. Wadhwa, and D.F. Lemmerhirt, “*Characterization and Modeling of Capacitive Micromachined Ultrasound Transducers for Diagnostic Ultrasound*” in Proceedings of the ASME IMECE, Boston, MA, October 31-November 6, 2008.

J. S. Krause, R. D. White, M. J. Moeller, J. M. Gallman, and R. deJong, “*MEMS Pressure Sensor Array for Aeroacoustic Analysis of the Turbulent Boundary Layer*” in Proceedings of the ASME IMECE, Boston, MA, October 31-November 6, 2008.

S. Liu, D. A. Gauthier, E. Mandelup, and R. D. White, “*Experimental Investigation of a Hydromechanical Scale Model of the Gerbil Cochlea*” in Proceedings of the ASME IMECE, Boston, MA, October 31-November 6, 2008.

D. Gauthier, A. Mueller, R. White, V. Manno, C. Rogers, S. Anjur and M. Moinpour, “*Micromachined Force Sensors for Characterization of Chemical Mechanical Polishing*” in Proceedings of Nanotech 2008, Boston, MA, June 1-6, 2008.

J.S. Krause, R.D White, M.J. Moeller, J.M. Gallman and R. De Jong, “*MEMS Pressure Sensor Array for Aeroacoustic Analysis of the Turbulent Boundary Layer on an Airplane Fuselage*” in Proceedings of Nanotech 2008, Boston, MA, June 1-6, 2008.

P. D. Fallon, A.P. Gerratt, B.P. Kierstead, and R.D. White, “*Shape Memory Alloy and Elastomer Composite MEMS Actuators*” in Proceedings of Nanotech 2008, Boston, MA, June 1-6, 2008.

C.B. Doody, J.S. Wadhwa, D.F. Lemmerhirt, and R.D White, “*Characterization and Modeling of Capacitive Micromachined Ultrasound Transducers for Diagnostic Ultrasound*” in Proceedings of Nanotech 2008, Boston, MA, June 1-6, 2008.

Meghan Kate, Greg Bettencourt, James Marquis, Aaron Gerratt, Peter Fallon, Brian Kierstead, Robert White and Barry Trimmer, “*SoftBot: A soft-material flexible robot based on caterpillar biomechanics*”, in Adaptive Movement in Animals and Machines, AMAM 2008, Cleveland, OH, June 1-6, 2008.

Hughes, M.F., Sanayei, M., Moore, J.A., Zapfe, J.A., and White, R.D., “*Experimental Validation of Building Vibration Propagation Using a Four Story Laboratory Model*,” in the Proceedings of the ASCE, Structures Congress 2008, Vancouver, Canada, April 24-26, 2008.

D. Gauthier, A. Mueller, R. D. White, V. Manno, C. Rogers, D. Hooper, S. Anjur, M. Moinpour, “*Micromachined Lateral Force Sensors for Characterization of Microscale Surface Forces During*

Chemical Mechanical Polishing." in the Proceedings of the Materials Research Society, MRS Spring Meeting, March 24-28, 2008.

N. Braun, C. Gray, A. Mueller, J. Vlahakis, D. Gauthier, V. P. Manno, C. Rogers, R. White, S. Anjur, M. Moinpour. "*In-Situ Investigation of Wafer-Slurry-Pad Interactions during CMP*" in the Proceedings of the International Conference on Planarization/CMP Technology, Dresden, Germany, October 25-27, 2007.

Tsioris, K., White, R. D., Kaplan, D., and Wong, P. "*The Effect of Hydrophobic Patterning on Micromolding of Aqueous-Derived Silk Structures*" in the Proceedings of the Material Research Society, MRS Fall Meeting, November 26-30, 2007.

White, R. D., Littrell, R., and Grosh, K. "*Copying the Cochlea: Micromachined Biomimetic Acoustic Sensors*" in Structural Health Monitoring 2007, Quantification, Validation and Implementation, Fu-Kuo Chang, ed. Volume 2, pp. 1447-1454, DesTECH Publications, Inc. 2007.

Mueller, A. White, R. D., Manno, V., Rogers, C., Barns, C. E., Anjur, S., and Moinpour, M. "*Micromachined Shear Stress Sensors for Characterization of Surface Forces During Chemical Mechanical Polishing*" in the Proceedings of the Material Research Society, Vol. 991, Symposium C, Advances and Challenges in Chemical Mechanical Planarization, 2007.

Gray, C., Rogers, C. Manno, V., White, R., Moinpour, M., Anjur S. "*Determining Pad-Wafer Contact using Dual Emission Laser Induced Fluorescence*", in the Proceedings of the Material Research Society, Vol. 991, Symposium C, Advances and Challenges in Chemical Mechanical Planarization, 2007.

Mueller, A., and White, R. D. "*Residual stress variation in polysilicon thin films*", in Proceedings of the 2006 ASME IMECE.

Stone, N., Kaiser, K., and White, R. D. "*Autotuning of a PID controller for an active vibration suppression device for the treatment of Essential Tremor*", in Proceedings of the 2006 ASME IMECE.

White, R. D. and Grosh, K. "*Fully micromachined lifesize cochlear model*" in Auditory Mechanisms: Processes and Models, A.L. Nuttall, ed., World Scientific, 2006.

White, R. D. and Grosh, K. "*Trapped-fluid traveling wave filters based on the mammalian cochlea*", in Proceedings of the μ TAS 2005 Conference, Ninth International Conference on Miniaturized Systems for Chemistry and Life Science, K. F. Jensen, J. Han, D. J. Harrison, and J. Voldman, eds., pp. 666-668.

Galbraith, C., White, R. D., Grosh, K., and Rebeiz, G. M. "*A mammalian cochlea-based RF channelizer filter*" in Microwave Symposium Digest, 2005 IEEE MTT-S International, 12-17 June 2005 pp. 1935-1938.

White, R. D., Cheng, L., and Grosh, K. "*Capacitively sensed micromachined hydrophone with viscous fluid-structure coupling*", Proceedings of the SPIE, *Photonics West 2005*, 5718 (121), pp. 89-100.

White, R. D. and Grosh, K. "*A micromachined cochlear-like acoustic sensor*", in Proceedings of the SPIE, vol. 4700, 2002, pp. 89-100.

White, R. D. and Grosh, K. "*Design and characterization of a MEMS piezoresistive cochlear-like acoustics sensor*", in Proceedings of the 2002 ASME IMECE.

Borenstein, J., Gerrish, N., White, R., Curie, M., and Fitzgerald, E. "*Silicon germanium epitaxy: a new material for MEMS*", in Proceedings of the MRS, vol. 657, 2000, pp EE7.4.1-EE7.4.6.

Invited Talks and Selected Conference Presentations

White, R. D., "MEMS Acoustic Arrays and Shear Sensor Arrays", Draper Labs Technical Seminar Series, August 5, 2009. **Invited Talk.**

White, R., Vlahakis, J.* , Gray, C., Manno, V., Braun, N., Gauthier, D., Mueller, A., Rogers, C. and Moinpour, M. “*In Situ Characterization of the Mechanical Aspects of CMP*” at the International Conference on Planarization/CMP Technology 2008, Hsinchu, Taiwan, November 10, 2008.

White, R.D. “*Copying the Cochlea: Biomimetic Acoustic Sensors*”. Florida State University, High Performance Materials Institute Distinguished Speaker Series. Tallahassee, Florida, October 31, 2008. **Invited Talk.**

White R. D., Rogers, C., and Manno, V. P., “*In Situ Characterization of the Mechanical Aspects of CMP*” presented at the SRC/Sematech ERC on Environmentally Benign Semiconductor Manufacturing Teleseminar series on September 18, 2008.

White, R. D. “*Teaching Undergraduate System Dynamics and Controls with Lego*”, presented at the “Teaching with Robots” Workshop at the Robotics, Science and Systems Conference, Zurich, Switzerland, June 29, 2008.

White, R. D., R. Littrell, and K. Grosh “*Copying the Cochlea: Micromachined Biomimetic Acoustic Sensors*” presented at the International Workshop on Structural Health Monitoring 2007, Stanford University, Palo Alto, CA, September 13, 2007. **Invited Talk.**

White, R. D. “*Copying the Cochlea: Micromachined Biomimetic Acoustic Sensors Based on the Mammalian Cochlea*”, presented at the Massachusetts Institute of Technology “Mechanics: Modeling, Experimentation, and Computation” Seminar, Cambridge, MA, February 27, 2007. **Invited Talk.**

Tsioris, K.*, White, R. D., Kaplan, D., and Wong, P. “*The Effect of Hydrophobic Patterning on Micromolding of Aqueous-Derived Silk Structures*” presented at the Material Research Society Fall Meeting, Boston, MA, November 26-30, 2007.

Liu, S.* and White, R. D. “*Orthotropic material properties of the gerbil basilar membrane.*” presented at the 154th Meeting of the Acoustical Society of America, New Orleans, LA, November 28, 2007.

N. Braun, C. Gray, A. Mueller, J. Vlahakis, D. Gauthier, V. P. Manno, C. Rogers, R. White, S. Anjur, M. Moinpour*. “*In-Situ Investigation of Wafer-Slurry-Pad Interactions during CMP*” presented at the International Conference on Planarization/CMP Technology, Dresden, Germany, October 2007.

Stone, N.*, Kaiser, K., and White, R. D. “*Autotuning of a PID controller for an active vibration suppression device for the treatment of Essential Tremor*”, presented at the 2006 ASME IMECE, Chicago, IL, November 5-8, 2006.

Honors

Rackham Predoctoral Fellowship, Univ. of Michigan	2004-2005
NSF Graduate Research Fellowship	2001-2004
Honorable Mention, Hertz Foundation Graduate Fellowship	2001
Draper Fellowship, CS Draper Labs, Cambridge, MA	1998-1999

* Presenting author, if other than R. White.

Grants and Contracts

As Principle Investigator:

“In Situ Characterization of Chemical Mechanical Planarization on Patterned Substrates”, SRC/Sematech Engineering Research Center on Environmentally Benign Semiconductor Manufacturing, customized project for Intel Corporation. \$64,521 total costs, PI, 9/1/08-8/31/09.

“Phase II: Micromachined pressure and shear-stress sensor arrays for turbulent boundary layer characterization”, Spirit Aerosystems, Wichita, KS, \$155,159 direct, \$73,439 indirect. Sole PI. 9/1/07-8/31/09.

“Modeling and Characterization of Micromachined Ultrasound Elements”, Sonetics Ultrasound, Ann Arbor, MI, \$37,212 direct, \$4,792 indirect. Sole PI. 6/1/07-5/31/08. Contract extended through 5/31/09 with an additional \$25,763 in total costs.

“Micromachined pressure and shear-stress sensor arrays for turbulent boundary layer characterization”, Spirit Aerosystems, Wichita, KS, \$57,697 direct, \$29,483 indirect, sole PI, 9/1/06-8/31/07.

“Undergraduate Education in Microfabrication Processing”, Lufkin Trust, \$278,000 direct, 7/1/06-6/30/08.

As Co-Principle Investigator or Senior Personnel:

“Phase II: Biodegradable Communications Systems”, Defense Advanced Research Projects Agency (DARPA), \$4,727,468 total costs, Senior Personnel, 2/1/09-1/31/10.

“NTF Flow Quality Characterization for Laminar Flow Testing”, Vigyan, Inc., \$199,582 total costs, Co-PI, 10/1/08-9/30/09.

“Chemical Robots: morphing, soft-material robots for covert access”, Defense Advanced Research Projects Agency (DARPA), \$3,298,209 total costs, Senior Personnel, 2/14/08-2/13/10.

“Chemical Communications: Biodegradable Communications Systems”, Defense Advanced Research Projects Agency (DARPA), \$2,653,849 total costs, Senior Personnel, 10/1/07-9/30/08.

“Biomimetic Technologies for Soft-Bodied Robots”, W. M. Keck Foundation, \$730,000 direct, Senior Personnel. Awarded January 2007.

Professional Societies

American Society of Mechanical Engineers (ASME). Session chair at ASME International Mechanical Engineering Congress and Exposition (IMECE), Mechatronics IV.

American Institute of Aeronautics and Astronautics (AIAA)

Institute of Electrical and Electronics Engineers (IEEE)

Acoustical Society of America (ASA)