

## GEORGE T.-C. CHIU

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### RESEARCH INTERESTS

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Mechatronics; Dynamic Systems and Control; Digital Imaging and Printing Systems; Functional Printing and Digital Fabrication; Robotics; Perception-based Engineering; Human Motor Control; Optimal and Robust Control;

### EDUCATION

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**Ph.D.** Mechanical Engineering, University of California at Berkeley, May 1994.

**M.S.** Mechanical Engineering, University of California at Berkeley, May 1990.

**B.S.** Mechanical Engineering, National Taiwan University, Taipei, Taiwan, June 1985.

### PROFESSIONAL EXPERIENCE

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01/18 – present **Assistant Dean for Global Engineering Programs and Partnerships**  
College of Engineering, Purdue University

08/08 – present **Professor**

10/08 – 09/11 **Director of Professional Practice and Global Initiatives**

08/02 – 07/08 **Associate Professor**

06/96 – 07/02 **Assistant Professor**  
School of Mechanical Engineering, Purdue University.

07/12 – present **Professor** (by courtesy)  
Department of Psychological Sciences, Purdue University.

08/08 – present **Professor** (by courtesy)  
School of Electrical and Computer Engineering, Purdue University.

01/17 – present **Editor-in-Chief, IEEE/ASME Transactions on Mechatronics**

01/12 – 06/14 **Editor, Journal of Imaging Science and Technology**  
Society for Imaging Science and Technology, Springfield, Virginia.

09/11 – 06/14 **Program Director**  
National Science Foundation, Arlington, Virginia.

07/05 – 08/05 **Visiting Scholar**  
Department of Mechanical Engineering, Waseda University, Tokyo, Japan.

02/05 – 07/05 **Visiting Associate Professor**  
School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai, China.

06/00, 06/01,  
06/02 **Visiting Summer Faculty**  
Hewlett-Packard Company, Boise, Idaho.

04/94 – 05/96 **Hardware Design Engineer**  
Hewlett-Packard Company, San Diego, California.

## AWARDS AND HONORS

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- Fellow*, American Society of Mechanical Engineers (ASME), 2013
- Director's Collaboration Award*, National Science Foundation, 2012
- Fellow*, The Society for Imaging Science and Technology (IS&T), 2011
- Outstanding Volunteer Award*, FIRST Robotics Competition, Boilermaker Regional, 2011
- 2010 IEEE Transactions on Control Systems Technology Outstanding Paper Award*, Control Systems Society, IEEE, 2010
- Faculty Engagement/Service Excellence Award*, College of Engineering, Purdue University, 2010
- Team Excellence Award*, College of Engineering, Purdue University, 2006
- Best Poster Session Paper and Presentation Award*, NIP21: The 21st International Congress on Digital Printing Technologies, Baltimore, Maryland, September 2005
- The Ruth and Joel Spira Award*, School of Mechanical Engineering, Purdue University, 2004
- Teaching for Tomorrow Award*, Purdue University, 2000
- Feddersen Fellow*, School of Mechanical Engineering, Purdue University, 1996-1997
- Outstanding Graduate Student Instructor*, University of California, Berkeley, 1990-1991

## PUBLICATIONS

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### Archival Journals

#### **In Review**

- [1] W. Novotny, A. Murray, N. Bajaj, J. Miller, T. Fleck, R. Ramachandran, I. Gunduz, S. Son, G. Chiu, and J. Rhoads, "Metallic Bridge Wires Printed on a Flexible Substrate Without Thermal Curing," *Flexible Printed Electronics*, submitted in October 2017.
- [2] N. Murrell, R. Bradley, N. Bajaj, J. Whitney, and G.T.-C. Chiu, "A Method for Sensor Reduction in a Supervised Machine Learning Classification System," *IEEE/ASME Transactions on Mechatronics*, submitted in September 2017.
- [3] N. Bajaj, G.T.-C. Chiu, and J. Rhoads, "A Megahertz-Frequency Tunable Piecewise-Linear Electromechanical Resonator Realized via Nonlinear Feedback," *Journal of Sound and Vibration*, submitted in August 2017.
- [4] A. Murry, W. Novotny, T. Fleck, I.E. Gunduz, S. Son, G. Chiu and J. Rhoads, "Selectively-Deposited Energetic Materials: A Feasibility Study of the Piezoelectric Inkjet Printing of Nanothermites," *Additive Manufacturing*, submitted in March 2017.

#### **2018**

- [5] J-S. Hyun, G.T.-C. Chiu, and S. Zhang, "High-speed and High-accuracy 3D Surface Measurement using a Mechanical Projector," *Optics Express*, Vol. 26, Iss. 2, pp. 1474-1487, 2018, [10.1364/OE.26.001474](https://doi.org/10.1364/OE.26.001474)

#### **2017**

- [6] M. Wadas, M. Tweardy, N. Bajaj, A. Murray, G.T.-C. Chiu, E. Nauman, and J. Rhoads, "Detection of Traumatic Brain Injury Protein Biomarkers with Resonant Microsystems," *IEEE Sensors Letters*, Vol. 1, No. 6, pp. 1-4, December 2017, [10.1109/LSSENS.2017.2768514](https://doi.org/10.1109/LSSENS.2017.2768514)
- [7] S. Jin, Y. Heo, L-K. Lin, A. Deering, G.T.-C. Chiu, J.P. Allebach and L.A. Stanciu, "Gold Decorated Polystyrene Particles for Lateral Flow Immunodetection of Escherichia coli O157:H7," *Microchimica Acta*, Vol. 184, Iss. 12, pp. 4879-4886, December 2017, [10.1007/s00604-017-2524-5](https://doi.org/10.1007/s00604-017-2524-5)

- [8] A.K. Murray, T. Isik, V. Ortalan, I.E. Gunduz, S. Son, G. Chiu, and J. Rhoads, "Two-Component Additive Manufacturing of Nanothermite Structures via Reactive Inkjet Printing," *Journal of Applied Physics*, Vol. 122, Iss. 18, 184901, November 2017. [10.1063/1.4999800](https://doi.org/10.1063/1.4999800)
- [9] N. Bajaj, J.F. Rhoads, and G.T.-C. Chiu, "Characterization of Resonant Mass Sensors Using Inkjet Deposition," *ASME Journal of Dynamic Systems, Measurements and Control*, Vol. 139, No. 11, pp. 114505-1-114505-6, November 2017, [10.1115/1.4036873](https://doi.org/10.1115/1.4036873)
- [10] T. Fleck, A. Murray, I.E. Gunduz, S. Son, G. Chiu, and J. Rhoads, "Additive Manufacturing of Multifunctional Reactive Materials," *Additive Manufacturing*, Vol. 17, pp. 176-182, October 2017, [10.1016/j.addma.2017.08.008](https://doi.org/10.1016/j.addma.2017.08.008)
- [11] T. Fleck, A. Murry, W. Novotny, I.E. Gunduz, S. Son, G. Chiu, and J. Rhoads, "Controlled Substrate Destruction using Nanothermite," *Propellants, Explosives, Pyrotechnics*, Vol. 42, Iss. 6, pp. 579-584, June 2017, [10.1002/prep.201700008](https://doi.org/10.1002/prep.201700008)
- [12] M. Mukhtar, J. Yi, and G.T.-C. Chiu, "Color Registration Error Reduction in Flatbed Document Scanner using Iterative Velocity Command Synthesis," *Journal of Imaging Science and Technology*, Vol. 61, No. 3, pp. pp. 30504-1-10, May, 2017, [10.2352/J.ImagingSci.Technol.2017.61.3.030504](https://doi.org/10.2352/J.ImagingSci.Technol.2017.61.3.030504)

**2016**

- [13] B. Cheng, B.W. Tobalske, D.R. Powers, T.L. Hedrick, S.M. Wethington, G.T.-C. Chiu, and X. Deng, "Flight Mechanics and Control of Escape Maneuvers in Hummingbirds I. Flight Kinematics," *Journal of Experimental Biology*, Vol. 219, No. 12, pp. 3518-3531, November 15, 2016, [10.1242/jeb.137539](https://doi.org/10.1242/jeb.137539)
- [14] B. Cheng, B.W. Tobalske, D.R. Powers, T.L. Hedrick, Y. Wang, S.M. Wethington, G.T.-C. Chiu, and X. Deng, "Flight Mechanics and Control of Escape Maneuvers in Hummingbirds II. Aerodynamic Force Production, Flight Control and Performance Limitations," *Journal of Experimental Biology*, Vol. 219, No. 12, pp. 3532-3543, November 15, 2016, [10.1242/jeb.137570](https://doi.org/10.1242/jeb.137570)
- [15] S. Sung, N. Bajaj, J. Rhoads, G. Chiu, and B. Boudouris, "Radical Polymers Improve the Metal-Semiconductor Interface in Organic Field-Effect Transistors," *Organic Electronics*, Vol. 37, pp. 148-154, October 2016, [10.1016/j.orgel.2016.06.020](https://doi.org/10.1016/j.orgel.2016.06.020)
- [16] B. Han, G.Y. Yun, J.W. Boley, S.H. Kim, J.Y. Hwang, G.T.-C. Chiu, and K. Park, "Dropwise Gelation-Dehydration Kinetics during Drop-on-Demand Printing of Hydrogel-based Materials," *International Journal of Heat and Mass Transfer*, Vol. 97, pp. 15-25, June 2016, [10.1016/j.ijheatmasstransfer.2016.01.030](https://doi.org/10.1016/j.ijheatmasstransfer.2016.01.030)
- [17] N. Bajaj, A. Sabater, J. Hickey, G.T.-C. Chiu, and J. Rhoads, "Design and Implementation of a Tunable, Duffing-Like Electromechanical Resonator Via Nonlinear Feedback," *IEEE Journal of Microelectromechanical Systems*, Vol. 25, Iss. 1, pp. 2-10, February 2016, [10.1109/JMEMS.2015.2493447](https://doi.org/10.1109/JMEMS.2015.2493447)
- [18] J. Mynderse and G.T.-C. Chiu, "Two Degree-of-Freedom Hysteresis Compensation for a Dynamic Mirror Actuator," *IEEE/ASME Transactions on Mechatronics*, Vol. 21, Iss. 1, pp. 29-37, February 2016, [10.1109/TMECH.2015.2493038](https://doi.org/10.1109/TMECH.2015.2493038)

**2014**

- [19] J.W. Boley, E.L. White, G.T.-C. Chiu, and R.K. Kramer, "Direct Writing Gallium-Indium Alloy for Stretchable Electronics," *Advanced Functional Materials*, Vol. 24, pp 3501-3507, June 2014, [10.1002/adfm.201303220](https://doi.org/10.1002/adfm.201303220)
- [20] J. Shelton and G.T.-C. Chiu, "Efficiently Generating the Ballistic Phase of Human-like Aimed Movement," *IEEE/ASME Transactions on Mechatronics*, Vol. 19, Iss. 6, pp. 1839 - 1846, December 2014, [10.1109/TMECH.2014.2316156](https://doi.org/10.1109/TMECH.2014.2316156)

- [21] J. Mynderse and G.T.-C. Chiu, "Modeling of a Dynamic Mirror with Antagonistic Piezoelectric Stack Actuation," *ASME Journal of Dynamic Systems, Measurement and Control*, Vol. 136, No. 2, pp. 0245011-02405105, March 2014, [10.1115/1.4025671](https://doi.org/10.1115/1.4025671)

**2013**

- [22] A. Adak, J.W. Boley, D. Lyvers, G.T. Chiu, P. Low, R. Reifenberger, and A. Wei, "Label-free Detection of Staphylococcus Aureus Captured on Immutable Ligand Microarrays," *ACS Applied Materials & Interfaces*, Vol. 5, Iss. 13, pp. 6404-6411, July 10, 2013 [10.1021/am4016236](https://doi.org/10.1021/am4016236);
- [23] M.H. Cheng, G.T.-C. Chiu and M.A. Franchek, "Real-Time Measurement of Eccentric Motion with Low-Cost Capacitive Sensor," *IEEE/ASME Transactions on Mechatronics*, Vol. 18, iss. 3, pp. 990-997, June 2013, [10.1109/TMECH.2012.2195323](https://doi.org/10.1109/TMECH.2012.2195323)
- [24] Y.-F. Kuo, G.T.-C. Chiu, and J.A. Allebach, "Calibration Color Patch Reduction and Halftone Level Selection for Electrophotography," *Journal of Imaging Science and Technology*, Vol. 57, No. 2, pp. 20505-1-20505, March/April 2013, [10.2352/J.ImagingSci.Technol.2013.57.2.020505](https://doi.org/10.2352/J.ImagingSci.Technol.2013.57.2.020505)

**2012**

- [25] V. Kumar, Y. Yang, J.W. Boley, G.T.-C. Chiu, and J.F. Rhoads, "Modeling, Analysis, and Experimental Validation of a Bifurcation-Based Microsensor," *IEEE/ASME Journal of Microelectromechanical Systems*, Vol. 21, No. 3, pp. 549-558, May 2012, [10.1109/JMEMS.2011.2182502](https://doi.org/10.1109/JMEMS.2011.2182502)
- [26] Y.-F. Kuo, C.-L. Yang, G. T.-C. Chiu, Y. Yih, J. P. Allebach, and C. D. Geleynse, "Experimental Characterization of Transient Tone Deviation in Print Jobs for Color Electrophotography," *Journal of Imaging Science and Technology*, Vol. 56, No. 2, p. 020502, February/March 2012, [10.2352/J.ImagingSci.Technol.2012.56.2.020502](https://doi.org/10.2352/J.ImagingSci.Technol.2012.56.2.020502)

**2011**

- [27] Y.-F. Kuo, C.-L. Yang, G.T.-C. Chiu, Y. Yih, J.P. Allebach, and D.A. Abramsohn, "Model-based Calibration Approach to Improve Tone Consistency for Color Electrophotography," *Journal of Imaging Science and Technology*, Vol. 55, No. 6, pp. 1-9, November/December 2011, [10.2352/J.ImagingSci.Technol.2011.55.6.060505](https://doi.org/10.2352/J.ImagingSci.Technol.2011.55.6.060505)
- [28] P.-J. Chiang, J.P. Allebach, and G.T.-C. Chiu, "Extrinsic Signature Embedding and Detection in Electrophotographic Halftoned Images through Exposure Modulation," *IEEE Transactions on Information Forensics and Security*, Vol. 6, No. 3 Part 2, September 2011, [10.1109/TIFS.2011.2156789](https://doi.org/10.1109/TIFS.2011.2156789)
- [29] F. Liu, G.T.-C. Chiu, E. Hamby, and Y. Eun, "Modeling and Control of a Hybrid Two-Component Development Process for Xerography," *IEEE Transactions on Control System Technology*, vol. 19, no.3, pp. 531-544, May 2011, [10.1109/TCST.2010.2048712](https://doi.org/10.1109/TCST.2010.2048712) – *2012 IEEE Transactions on Control Systems Technology Outstanding Paper Award Finalist*
- [30] V. Kumar, J.W. Boley, Y. Yang, H. Ekowaluyo, J.K. Miller, G.T.-C. Chiu, and J.F. Rhoads, "Bifurcation-based Mass Sensing using Piezoelectrically-actuated Microcantilevers," *Applied Physics Letters*, Vol. 98, Iss. 15, p. 153510, April 2011, [10.1063/1.3574920](https://doi.org/10.1063/1.3574920)
- [31] O-S. Kwon, H. N. Zelaznik, G. Chiu, and Z. Pizlo, "Human Motor Transfer is Determined by the Scaling of Size and Accuracy of Movement," *Journal of Motor Behavior*, Vol. 43, Iss. 1, pp. 15-26, 2011. [10.1080/00222895.2010.520359](https://doi.org/10.1080/00222895.2010.520359)

**2010**

- [32] Y.-F. Kuo, C.-L. Yang, Y. Yih, G.T.-C. Chiu, and J.P. Allebach, "Improving Tone Prediction in Calibration of Electrophotographic Printers by Linear Regression: Using Principal Components to Account for Collinearity of Sensor Measurements," *Journal of Image Science and Technology*, Vol. 54, No. 5, pp. 050302-050302-9, September/October 2010, [10.2352/J.ImagingSci.Technol.2010.54.5.050302](https://doi.org/10.2352/J.ImagingSci.Technol.2010.54.5.050302)

- [33] C.-L. Yang, Y.-F. Kuo, Y. Yih, G.T.-C. Chiu, D.A. Abramsohn, G.R. Ashton, and J.P. Allebach, "Improving Tone Prediction in Calibration of Electrophotographic Printers by Linear Regression: Environmental, Consumables, and Tone-Level Factors," *Journal of Image Science and Technology*, Vol. 54, No. 5, pp. 050301-050301-11, September/October 2010, [10.2352/J.ImagingSci.Technol.2010.54.5.050301](https://doi.org/10.2352/J.ImagingSci.Technol.2010.54.5.050301)
- [34] T. Bhuvana, W. Boley, B. Radha, B. Hines, G. Chiu, D. Bergstrom, R. Reifenberger, T.S. Fisher, and G.U. Kulkarni, "Inkjet Printing of Palladium Alkanethiolates for Facile Fabrication of Metal Interconnects and SERS Substrates," *Micro & Nano Letters*, Vol. 5, Iss. 5, pp. 296-299, October 2010, [10.1049/mnl.2010.0109](https://doi.org/10.1049/mnl.2010.0109)
- [35] M.H.-M. Cheng and G.T.-C. Chiu, "A Mechatronic Approach to a Virtual Laboratory Service on Internet," *International Journal of Virtual Technology and Multimedia*, Vol. 1, No. 2, pp. 140-154, 2010, [10.1504/IJVTM.2010.032057](https://doi.org/10.1504/IJVTM.2010.032057)

**2009**

- [36] P-J Chiang, N. Khanna, A.K. Mikkilineni, M.V. Ortiz Segovia, S. Suh, J.P. Allebach, G.T.-C. Chiu, and E.J. Delp, "Printer and Scanner Forensics," *IEEE Signal Processing Magazine*, Vol. 26, Iss. 2, pp. 72-83, March 2009, [10.1109/MSP.2008.931082](https://doi.org/10.1109/MSP.2008.931082)

**2008**

- [37] H.-M. Cheng and G.T. Chiu, "Wordlength Estimation of Digital Controller Synthesis for Inkjet Printer Mechanism," *Journal of Computers*, Vol. 3, No. 4, pp. 50-57, April 2008.
- [38] M. H.-M. Cheng, G.T.-C. Chiu, and R. Reifenberger, "Fractal Compression and Adaptive Sampling: Reducing the Image Acquisition Time in Scanning Probe Microscopy," *Scanning*, Vol. 30, Iss. 6, pp. 463-473, November 2008.
- [39] C.-L. Chen, G.T.-C. Chiu, and J. A. Allebach, "Halftone Banding Reduction for a Class of Electrophotographic Systems - Part I: Characterization and Modeling," *Mechatronics*, Vol. 18, No. 4, pp. 400-411, October 2008.
- [40] C.-L. Chen and G.T.-C. Chiu "Halftone Banding Reduction for a Class of Electrophotographic Systems - Part II: Closed-loop Control," *Mechatronics*, Vol. 18, No. 4, pp. 412-425, October 2008.
- [41] C.-L. Chen and G.T.-C. Chiu, "Closed Loop Banding Artifact Reduction for a Class of Color Electrophotographic Printers with Underactuated Motor/Gear Configuration," *IEEE Transactions on Control Systems Technology*, Vol. 16, No. 4, pp. 577-588, July 2008. - *2010 IEEE Transactions on Control Systems Technology Outstanding Paper Award*
- [42] C.-Y. Chen, L.-Q. Liu, P.-S. Liao, and G.T.-C. Chiu, "Fuzzy Controller Design for Synchronous Motion in a Dual-Cylinder Electro-Hydraulic System," *IFAC Journal of Control Engineering Practice*, Vol. 16, pp. 658-673, June 2008.
- [43] C.-Y. Chen and G.T.-C. Chiu, " $H_{\infty}$  Robust Controller Design of Media Advance Systems with Time Domain Specifications," *International Journal of Innovative Computing, Information and Control*, Vol. 4, No. 4, pp. 813-828, April 2008.
- [44] C.-L. Chen and G.T.-C. Chiu, "Spatially Periodic Disturbance Rejection with Spatially Sampled Robust Repetitive Control," *ASME Journal of Dynamic Systems, Measurement and Control*, Vol. 130, Iss. 2, pp. 021002-1-021002-11, March 2008.

**2007**

- [45] C.-Y. Chen and G. T.-C. Chiu "Design and Control Integration of Media Advance Systems for Thermal Inkjet Printers," *Journal of Mechanical Engineering Science (Part C)*, Vol. 221, pp. 739-750, June 2007.

**2006**

- [46] C.-L. Chen, G.T.-C. Chiu and J.A. Allebach, "Robust Spatial-sampling Controller Design for Banding Reduction in Electrophotographic Process," *Journal of Image Science and Technology*, Vol. 50, No. 6, pp. 530-536, November/December 2006.
- [47] N. Khanna, A.K. Mikkilineni, A.F. Martone, G.N. Ali, G.T.-C. Chiu, J. P. Allebach and E. J. Delp, "A Survey of Forensic Characterization Methods for Physical Devices," *Digital Investigation*, Vol. 3, Sup. 1, pp. 17-28, September 2006.

**2005**

- [48] K.A. Williams, G.T.-C. Chiu, and R.J. Bernhard, "Nonlinear Control of a Shape Memory Alloy Adaptive Tuned Vibration Absorber," *Journal of Sound and Vibration*, Vol. 288, Iss. 4-5, pp. 1131-1155, December 2005.
- [49] Y. Li, M. Rotea, G.T.-C. Chiu, L. Mongeau, and I.S. Paek, "Extremum Seeking Control of Tunable Thermoacoustic Cooler," *IEEE Transactions on Control Systems Technology*, Vol. 13, No. 4, pp. 527-536, July 2005.
- [50] Y. Li and G.T.-C. Chiu, "Control of Loudspeakers Using Disturbance-Observer Type Velocity Estimation," *IEEE/ASME Transactions on Mechatronics*, Vol. 10, No. 1, pp. 111-117, February 2005.
- [51] K.A. Williams, G.T.-C. Chiu, and R.J. Bernhard, "Dynamic Modeling of a Shape Memory Alloy Adaptive Tuned Vibration Absorber," *Journal of Sound and Vibration*, Vol. 280, Iss. 1-2, pp. 211-234, February 2005.

**2004**

- [52] W. Jang, M. C. Chen, J.P. Allebach, and G.T.-C. Chiu, "Print Quality Test Page," *Journal of Imaging Science and Technology*, Vol. 48, pp. 432-446, September/October 2004.
- [53] Y. Li, G.T.-C. Chiu, and L. Mongeau, "Dual-Driver Standing Wave Tube: Acoustic Impedance Matching with Robust Repetitive Control," *IEEE Transactions on Control Systems Technology*, Vol. 12, No. 6, pp. 869-880, November 2004.
- [54] Y. Li, I.S. Paek, G.T.-C. Chiu, L.G. Mongeau, and J. E. Braun, Reply to comments on "Adaptive tuning of an electrodynamically driven thermoacoustic cooler [J. Acoust. Soc. Am. 111, 1251-1258 (2002)]," *Journal of the Acoustical Society of America*, Vol. 115, Iss. 3, pp. 976-979, March 2004.

**2003**

- [55] C.-L. Chen, G.T.-C. Chiu, and Jan P. Allebach, "Banding Reduction in Electrophotographic Processes Using Human Contrast Sensitivity Function Shaped Photoconductor Velocity Control," *Journal of Image Science and Technology*, Vol. 47, No. 3, pp. 209-223, May/June 2003.

**2002**

- [56] M. Ewe, J. Grice, G.T.-C. Chiu, J. Allebach, C.S. Chan, and W. Foote, "Banding Reduction in Electrophotographic Processes Using Piezoelectric Actuated Laser Beam Deflection Device," *Journal of Image Science and Technology*, Vol. 46, No. 5, pp. 433-442, September/October 2002.
- [57] C.-C. Cheng, C.-Y. Chen, and G.T.-C. Chiu, "Predictive Control with Enhanced Robustness for Precision Positioning in Frictional Environment," *IEEE/ASME Transactions on Mechatronics*, Vol. 7, No. 3, pp. 385-392, September 2002.
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**2001**

- [63] H.M. Cheng, M.T.S. Ewe, R. Bashir, and G.T.-C. Chiu, "Modeling and Control of Piezoelectric Cantilever Beam Micro-Mirror and Micro-Laser Array to Reduce Image Banding in Electrophotographic Processes," *Journal of Micromechanics and Microengineering*, Vol. 11, No. 5, pp. 487-498, September 2001.
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- [66] C.Y. Chen, C.C. Cheng, G.T.-C. Chiu, and H. Peng "Passive Voice-Coil Feedback Control of Closed-Box Subwoofer Systems," *Journal of Mechanical Engineering Science (Part C)*, Vol. 214, pp. 995-1005, 2000.
- [67] B. Yao, F. Bu, J. Reedy, and G.T.-C. Chiu, "Adaptive Robust Motion Control of Single-Rod Hydraulic Actuators: Theory and Experiments," *IEEE/ASME Transactions on Mechatronics*, Vol. 5, No. 1, pp. 79-91, March 2000.
- [68] C.Y. Chen, C.C. Cheng, and G.T.-C. Chiu, "Adaptive Robust Control of Media Advance Systems for Thermal InkJet Printers," *Mechatronics*, Vol. 10, Iss. 1-2, pp. 111-126, 2000.

**1998**

- [69] G.T.-C. Chiu and M. Tomizuka, "Coordinated Position Control of Multi-Axis Mechanical Systems," *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol. 120, No. 3, pp. 389-393, September 1998.

**1992**

- [70] M. Tomizuka, J.-S. Hu, T.-C. Chiu and T. Kamano, "Synchronization of Two Motion Control Axes Under Adaptive Feedforward Control," *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol. 114, No 2, pp. 196-203, June 1992.

**Refereed (Full Paper) Conference Proceedings**

**2016**

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## INVITED SPEAKER AND PANELIST

- [1] Chinese Academy of Science, Beijing, China, "Efficient Generation of Human-like Kinematics in the Ballistic Phase of Point-to-Point Movement," November 21, 2017
- [2] Tsing Hua University, Beijing, China, "Making of a Microresonator-based Sensor - Feedback and Functional Printing," November 20, 2017
- [3] Yonsei University, Seoul, South Korea, "Embedded Implementation of Support Vector Machines Classification for Process Monitoring and Control," June 7, 2017
- [4] Control Systems Forum, Missouri University of Science and Technology, Rolla, Missouri, "Modeling and Control of Digital Printing and Imaging Systems," April 13, 2017

- [5] Interaction Meeting of Indo-US R&D Networked Joint Center on Nanomaterials for Clean Energy and Environmental Sensors, Bengaluru, India, "Real-time Defect Detection and Classification for Roll-to-Roll Gravure Coating of Cellulose Nanocrystal Thin Films," March 13, 2017
- [6] City University of Hong Kong, Hong Kong, "Functional Inkjet Printing - Opportunities and Challenges," November 21, 2016
- [7] 2016 Science, International Robotics Alliance Conference, Foshan, China, "Embedded Implementation of Machine Learning with Human Guidance," September 27, 2016 (Keynote)
- [8] Workshop on Intelligent Manufacturing, 2016 IEEE International Conference on Advanced Intelligent Mechatronics (AIM), Banff, Canada, "Recent Results Addressing Embedding Support Vector Machines (SVM) for Process Monitoring and Control," July 12, 2016 (Panelist)
- [9] University of Texas at Austin, Austin, Texas, "Functional Inkjet Printing - Opportunities and Challenges," November 4, 2015 (Chevron Frontier of Mechanical Engineering Distinguished Lecture)
- [10] Singapore University of Technology and Design, Singapore, "Functional Inkjet Printing - Opportunities and Challenges," October 22, 2015
- [11] Ohio State University, Columbus, Ohio, "Recent Results in Addressing Embedded Implementation of Support Vector Machines (SVM)," September 11, 2015
- [12] The 1<sup>st</sup> International Conference on Advanced Imaging, Tokyo, Japan, "Print Mask Design and Drop Volume Modulation for Functional Inkjet Printing," June 17, 2015 (Invited Lecture)
- [13] Shanghai Jiao Tong University, Shanghai, China, "Mechatronics Engineering - Challenges and Opportunities," May 19, 2015
- [14] Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India, "Process Control for Inkjet Printing of Functional Materials," March 19, 2015
- [15] University of Newcastle, Newcastle, Australia, "Mechatronics Engineering - Research and Education," December 5, 2014
- [16] United Technology Research Center, Hartford, Connecticut, "Modeling and Control of Digital Printing Systems and its Application to Functional Printing," July 24, 2014
- [17] Workshop on Intelligent Manufacturing, 2014 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics (AIM), Besançon, France, "Functional Inkjet Printing - Addressing Material-Substrate-Material Interaction," July 7, 2014 (Panelist)
- [18] Rutgers, The State University of New Jersey, New Jersey, "Print Mask Design to Address Material-Substrate Interaction in Functional Inkjet Printing," February 12, 2014
- [19] The 2<sup>nd</sup> International Conference on Intelligent Technologies and Engineering Systems (ICITES 2013), Kaohsiung, Taiwan, "Functional Inkjet Printing - Integrate Material and Process to Deliver Functionality," December 13, 2013 (Keynote)
- [20] National Taiwan University, Taipei, Taiwan, "Functional Inkjet Printing - Integrate Material and Process to Deliver Functionality," December 5, 2013
- [21] National Taiwan Science and Technology University, Taipei, Taiwan, "Functional Inkjet Printing - Integrate Material and Process to Deliver Feature," December 4, 2013
- [22] 2013 CACS International Automatic Control Conference, Sun Moon Lake, Nantou, Taiwan, "Control for Smart Manufacturing," December 3, 2013 (Invited Panelist)
- [23] Lexmark Career Start Symposium, Lexington, Kentucky, "Making Industry-University Collaboration Work - a Personal Perspective," July 25, 2013
- [24] Hubei Industrial University, Wuhan, China, "Efficient Generation of Human-like Kinematics in the Ballistic Phase of Point-to-Point Movement," July 2, 2013

- [25] Huazhong University of Science and Technology, Wuhan, China, "Efficient Generation of Human-like Kinematics in the Ballistic Phase of Point-to-Point Movement," July 1, 2013
- [26] Dynamic Walking 2013 Annual Meeting, Pittsburg, Pennsylvania, "The National Robotic Initiative and Beyond," June 10, 2013
- [27] The 3<sup>rd</sup> IFAC Symposium on Mechatronic Systems, Hangzhou, China, "Future Education in Mechatronics," April 12, 2013 (panelist)
- [28] University of Florida, Gainesville, Florida, "Efficient Generation of Human-like Kinematics in the Ballistic Phase of Point-to-Point Movement," March 21, 2013
- [29] University of Florida, Gainesville, Florida, "New Initiatives and Updates for Dynamic Systems and Control from the National Science Foundation," March 21, 2013
- [30] University of Minnesota, Minneapolis, Minnesota, "New Initiatives and Updates for Dynamic Systems and Control from the National Science Foundation," October 31, 2012
- [31] Villanova University, Villanova, Pennsylvania, "New Initiatives and Updates for Dynamic Systems and Control from the National Science Foundation," September 21, 2012
- [32] 2012 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Kaohsiung, Taiwan, "The Era of cloud Computing and Service Innovation: The Implication and Perspectives of Intelligent Mechatronics," July 13, 2012 (panelist)
- [33] Jiangsu Police Institute, Nanjing, China, "Printer and Sensor Forensics: Intrinsic and Extrinsic Signatures," December 12, 2011
- [34] 2011 RoSEC Winter School, Seoul, South Korea, "Perception-based Engineering," January 12, 2011
- [35] 2011 RoSEC Winter School, Seoul, South Korea, "End-of-Line Calibration of Repetitive Color Registration Error," January 13, 2011
- [36] International Conference on Engineering Design and Optimization, Ningbo, China, "Maintain Color Consistency - Modeling and Control of a Two-component Xerographic Development Process," October 28, 2010 (Keynote)
- [37] Waseda University, Tokyo, Japan, "Iterative Feedforward Repetitive Disturbance Rejection with Application to Document Scanners," June 21, 2010
- [38] University of Houston, Houston, Texas, "Maintain Color Consistency - Modeling and Control of a Two-component Xerographic Development Process," June 14, 2010
- [39] National Chung Hsin University, Taiwan, "Iterative Feedforward Repetitive Disturbance Rejection with Application to Document Scanners," June 11, 2010
- [40] National Chung Cheng University, Taiwan, "Iterative Feedforward Repetitive Disturbance Rejection with Application to Document Scanners," June 10, 2010
- [41] Cheng Shiu University, Kaohsiung, Taiwan, "Iterative Feedforward Repetitive Disturbance Rejection with Application to Document Scanners," June 9, 2010
- [42] Shanghai Jiao Tong University, Shanghai, China, "Recent Advances in Modeling and Control of Digital Imaging and Printing Systems," December 18, 2009
- [43] Harbin Institute of Technology, Harbin, China, "Modeling and Control of Digital Imaging and Printing Systems," June 23-25, 2009
- [44] Ricoh Company, Ebina, Japan, "Recent Research in the Modeling and Control of Digital Printing and Imaging Systems," June 17, 2009
- [45] Zhejiang University, Hangzhou, China, "Functionalize Microcantilever Sensor Array Using Inkjet Drop-on-Demand," November 18, 2008
- [46] Samsung Electronics, Suwon, South Korea, "Functionalization of Microcantilever Sensor Array Using Inkjet Drop-on-Demand," July 9, 2008

- [47] University of Washington, Seattle, Washington, "Modeling and Control of the Development Process in Electrophotography," November 30, 2007
- [48] ABET Annual Meeting, Lake Tahoe, Nevada, "The Purdue Global Engineering Alliance for Research and Education (GEARE) Program," November 6, 2007
- [49] United Technology Research Centers, Harford, Connecticut, "Identification of Color Banding Threshold for Laser Printers," February 27, 2007
- [50] Georgia Institute of Technology, Atlanta, Georgia, "Modeling and Control of a Two-Component Xerographic Development Process," December 8, 2006
- [51] University of Michigan, Ann Arbor, Michigan, "Modeling and Control of a Two-Component Xerographic Development Process," November 17, 2006
- [52] Bank of Canada, Ottawa, Canada, "Printer and Sensor Forensics," November 10, 2006 (with Dr. E Delp)
- [53] National Kaohsiung University of Applied Science, Kaohsiung, Taiwan, "Disturbance Observer Based Commutation Torque Estimation for Brushed Permanent Magnet Direct Current Motors - Modeling and Experimental Verification," October 24, 2006
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- [55] Yokohama National University, Yokohama, Japan, "Spatial Sampled Linear Parameter Varying Repetitive Control (LPVRC) - Disturbance Rejection in Electrophotography," July 13, 2006
- [56] Indiana University Purdue University Indianapolis (IUPUI), "Modeling and Control of Electrophotography: From Artifact Reduction to Signature Embedding," April 6, 2006
- [57] Feng Chia University, Taichung, Taiwan, "Banding in Electrophotography: From Artifact Reduction to Signature Embedding," October 6, 2005
- [58] National Changhua University of Education, Changhua, Taiwan, "Finite Precision Controller Implementation - Explore the Coupling between Sample Rate and Wordlength," October 5, 2005
- [59] National Chung Hsin University, Taichung, Taiwan, "Banding in Electrophotography: From Artifact Reduction to Signature Embedding," October 5, 2005
- [60] Waseda University, Kamogawa, Japan, "Campus Life for Engineering/Science Students in the United States," July 30, 2005
- [61] Waseda University, Tokyo, Japan, "Color Banding Metric and Digital Printing Research at Purdue University," July 27, 2005
- [62] Waseda University, Tokyo, Japan, "Banding in Electrophotography: From Artifact Reduction to Signature Embedding," July 21, 2005
- [63] Zhejiang University, Hangzhou, China, "Periodic Disturbance Rejection in Electrophotography - Spatial Sampled Linear Parameter Varying Repetitive Control," June 25, 2005
- [64] National Chiao Tung University, Hsinchu, Taiwan, "Extremum Seeking Control of Tunable Thermoacoustic Devices," May 11, 2005
- [65] Shanghai Jiao Tong University, Shanghai, China, "Periodic Disturbance Rejection in Electrophotography - Spatial Sampled Linear Parameter Varying Repetitive Control," November 24, 2004
- [66] National Changhua University of Education, Changhua, Taiwan, "Active and Adaptive-Passive Control of Acoustic Impedance Matching for Thermoacoustic Coolers," October 22, 2004
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- [73] Ricoh Research and Development Center, Yokohama, Japan, "Closed Loop Control of Electrophotographic Process - Sensitivity Reduction," June 20, 2003.
- [74] Institute of Industrial Science, University of Tokyo, Tokyo, Japan, "Artifact Rejection in Electrophotography using Linear Parameter Varying (LPV) System Formulation," June 19, 2003.
- [75] National Taiwan University, Taipei, Taiwan, "Artifact Rejection in Electrophotography using Linear Parameter Varying (LPV) System Formulation," June 13, 2003.
- [76] Metal Industries Research & Development Centre, Kaohsiung, Taiwan, "Perception Engineering and Mechatronics - Artifact Reduction in Electrophotographic Processes," December 24, 2002.
- [77] National Chiao-Tung University, Hsinchu, Taiwan, "Perception Engineering and Mechatronics - Artifact Reduction in Electrophotographic Processes," December 20, 2002.
- [78] Xerox Corporation, Webster, New York, "Sensing and Control of Digital Color Xerographic Imaging Systems," August 27, 2001, (with Dr. P. Li).
- [79] Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland, "Artifact Reduction in Digital Printing - a Need for Integrating Image Processing, Visual Perception and Process Control," July 16, 2001.
- [80] University of Illinois at Chicago, Chicago, Illinois, "Mechatronics - a Design Paradigm Shift and Its Applications," November 20, 2000.
- [81] Hewlett-Packard Company, Boise, Idaho, "Banding Reduction in Electrophotographic Processes," June 16, 2000.
- [82] Xerox Corporation, Webster, New York, "Mechatronics and Its Application in Document Printing Systems," May 18, 2000.
- [83] University of Michigan, Ann Arbor, Michigan, "Artifact Reduction in Electrophotographic Processes," March 31, 2000.
- [84] Unisys Corporation, Detroit, Michigan, "Developing Medium Volume Paper Handling Mechanisms," October 25, 1999.
- [85] National Sun Yat-San University, Kaohsiung, Taiwan, "Mechatronics - Integrated Design and Control of Electro-Mechanical Systems," June 21, 1999.
- [86] National Central University, Chungli, Taiwan, "Mechatronics - Integrated Design and Control of Electro-Mechanical Systems," June 19, 1999.
- [87] Lutron Electronics, "Mechatronics - Integrated Design and Control of Electro-Mechanical Systems," June 22, 1998.
- [88] General Motors Research Laboratories, Warren, Michigan, "Real-Time Estimation of Clutch Torque Based on Engine Torque Strut Force Measurement", August 15, 1989.

## **STUDENT MENTORING**

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### **PhD Degree Completed**

- [1] Keith A. Williams, PhD, 2001, "An Investigation of the Design and Control of Shape Memory Alloy Adaptive-Tuned Vibration Absorbers" - University of Alabama
- [2] Hong Sun, PhD, 2001, "Motion Synchronization of Multi-Cylinder Electro-Hydraulic Lift Systems" - Varian Medical Systems, California
- [3] Cheng-Lun Chen, PhD, 2003, "Modeling, Analysis and Robust Control for Electrophotographic Imaging Systems Subject to Spatially Periodic Disturbances and Measurable Nonlinearities" - National Chung Hsin University, Taiwan
- [4] Yaoyu Li, PhD, 2004, "Adaptive-Passive Impedance Matching for Acoustic Applications" - University of Texas at Dallas
- [5] Hung-Ming Cheng, PhD, 2005, "Encoding of Sampled-data Systems: Applications to Finite Wordlength Controller Implementation and Adaptive Sampling of Atomic Force Microscopy" - West Virginia University
- [6] Mu-Chih Chen, PhD, 2007, "Psychophysics Study and Reduction of Banding Artifact in Secondary Colors Using An Embedded Implementation of Closed-Loop Control on Multiple Motion Systems in an Electrophotographic Process." - Indiana Research Institute, Columbus, Indiana
- [7] Feng Liu, PhD, 2009, "Modeling and Control of a Two Component Development Process for Xerography" - Cummins, Indiana
- [8] Moeed Mukhtar, PhD, 2009, "Repetitive Motion Error Compensation through Iterative Learning based Calibration with Application to Flatbed Document Scanners" - Corning, New York
- [9] Pei-Ju Chiang, PhD, 2009, "Extrinsic Signatures Embedding and Detection in Electrophotographic Halftoned Images through Exposure Modulation" - National Chung Cheng University, Taiwan
- [10] Yan-Fu Kuo, PhD, 2011, "Improving Tone Consistency and Reducing Calibration Frequency for Color Electrophotography" - National Taiwan University, Taiwan
- [11] Aravind Mikkilineni, PhD, 2012, "Information Hiding in Printed Documents" - Oakridge National Laboratory, Tennessee
- [12] James Mynderse, PhD, 2012, "Two Degree-of-Freedom Hysteresis Compensation for a Dynamic Mirror with Antagonistic Piezoelectric Stack Actuation," - Lawrence Technological University, Michigan
- [13] Jeff Shelton, PhD, 2013, "Efficient Generation of Human-like Aiming Movement" - Purdue University, Indiana
- [14] J. Will Boley, PhD, 2013, "Print Mask Design for Inkjet Functional Printing," - Harvard University, Massachusetts
- [15] Nikhil Bajaj, PhD, 2017, "Microresonator-based Sensors with Feedback-Enabled Nonlinearities" - Purdue University, Indiana (with J. Rhoads)

### **MS Degree Completed**

- [1] Jeff Clark, MS (non-thesis), 1998, "Design of an Automatic Roll Compensator for the SteadiCam Systems" (with Dr. P. Meckl) - Lexmark
- [2] Grant Ingram, MS, 1999, "Robust Multivariable Control Systems for the Power Management of Wheel Loaders" (with Dr. M. Franchek) - General Electric



- [3] Michael T. Ewe, MS, 2000, "Halftone Banding Reduction in Electrophotographic Process using Piezoelectric Laser Beam Deflection Device" - Hewlett-Packard
- [4] Jaewook Ryu, MS, 2000, "Pulsed Laser Machining of Thin Films for Microsensor Development" (with Dr. X. Xu)
- [5] John Reedy, MS, 2001, "Design and Control of High Performance Electro-Hydraulic Systems" (with Dr. B. Yao) - Caterpillar
- [6] Mu-Chih Chen, MS (non-thesis), 2001, "Modeling of Electrophotographic Process" - Indiana Research Institute, Columbus, Indiana
- [7] Robert Witman, MS, 2001, "Java Based Multi-User Interface and Remote Control for Telemicroscopy" - RiffWare LLC
- [8] Ninad Shinde, MS, 2001, "Feasibility Study of the Design and Fabrication of a Mesoscaled Pulse-Tube Refrigeration System" (with Dr. R. Bashir) - Stroud Consulting
- [9] Anand Deshpande, MS, 2001, "DSP Based InkJet Printing System for Dynamic Print Mode Control" - Real-Time Innovation
- [10] Shivkumar Duraiswamy, MS, 2003, "Nonlinear Adaptive Nonsmooth Dynamic Surface Control of Electro-Hydraulic Systems" - GE Transportation Systems
- [11] Kyle Merrill, MS, 2003, "Nonlinear Observer Based Diagnostics for Electro-Hydraulic Systems" - Dennison Hydraulics
- [12] Krishna Subramanyam, MS, 2004, "An Experimental Study on the Use of Bluetooth® for Embedded Wireless Real-time Control" - Servo Tech
- [13] Dana Howard, MS, 2004, "Observer Based Commutation Torque Estimation in Brushed Permanent Direct Current Motors" - NextGen Aeronautics
- [14] James Mynderse, MS, 2004, "Design and Control of a Steering Wheel Vibration Simulator for Human Perception Testing" - Lawrence Technological University, Michigan
- [15] Kenji Totsuka, MS, 2005, "Tone Curve Stabilization for Color Electrophotography" - Lexmark
- [16] Yan-Fu Kuo, MS (non-thesis), 2005, "System Modeling and Sensitivity Analysis of Equivalent System Mass for Regenerative Solid Waste Treatment System in NASA Advances Life Support Systems" - National Taiwan University, Taiwan
- [17] Joshua R. McKinsey, MS, 2006, "Interfacing a Force-Feedback Joystick with a Hydraulic Robot Arm," - Toyota, USA
- [18] Benjamin Lovett, MS 2006, "Analysis and Characterization of PMDC Motor Commutation Torque Ripple" - Cummins, Indiana
- [19] Nick Post, MS, 2007 "Precision Micro-Deposition of Functional Layers Using Inkjet Drop-on-Demand and Applications to the Functionalization of Microcantilever Sensors" - Stryker, Michigan
- [20] Jun Cai, MS, 2007 "System Modeling and Optimal Control of Plant-Based Anaerobic-Aerobic Bioreactor Linked Operation (PAABLO) Subsystem in NASA Advanced Life Support System" - General Motors, Connecticut
- [21] Alamelu Ramaswamy, MS (ECE, non-thesis), 2008, "Lamp Intensity Regulation for Document Scanners"
- [22] Wei Sam Wong, MS (non-thesis), 2009
- [23] Divya Varadaraj, MS (non-thesis), 2010, "Supply Chain System Modeling, Analysis and Management" - 3M
- [24] Trever Owen, MSME, 2011, "Design and Control of a Hand Prosthesis"

- [25] Chenchao Shou, MSME, 2013, "A Study of Inkjet Printed Line Morphology Using Volatile Ink with Non-Zero Receding Contact Angle for Conductive Trace Fabrication" - UIUC
- [26] Aaron Fulton, MSME 2015, "Drop Volume Modulation via Modulated Contact Angle in Inkjet Systems"
- [27] Guixiang Zhao, MSME (non-thesis), 2015, "Functional Inkjet Printer Control"
- [28] Anurag Kumra, MSME, 2016 (non-thesis), "Backpressure Control for Functional Inkjet Printing" - Cummins, Indiana
- [29] Wei-Tai Chen, MSME 2016 (non-thesis), "Process Monitoring and Control for Roll-to-Roll Manufacturing of Nanocellulose based Film and Laminates Thermal and Vacuum Forming"

### **In Progress**

- [1] Jie Wang, PhD student, "Control of Roll-to-Roll Printing Processes"
- [2] Chun-Hao Hsu, PhD student, "Real-time 3D Imaging for Functional Printing"
- [3] Yumeng Wu, PhD student, "Coordinated Control for 3D Printing"
- [4] Josiah Thomas, PhD student, "Control with Bandwidth Limited Channels"
- [5] Cih Chang, PhD student, "Drop-on-Demand Inkjet Deposition of Hydrogel" (with B. Han)
- [6] De-Wei Chang, MS student, "Lower Arm Exoskeleton"

### **Undergraduate Student Research**

- [1] Chetan Kumar, Spring 1997, "Active Control of Closed Box Subwoofer Systems"
- [2] Ian Whiting, Spring 1997, "In-Situ Velocity Measurement of a Voice-Coil Actuator"
- [3] Alan Fung, Fall 1997, "Real-Time Control of Closed Box Subwoofer Systems using Voice-Coil BEMF Measurement"
- [4] Matthew S. Moses, Fall 1998, "Celluar Robot"
- [5] Avinash Aradhya, Fall 1998, "Electro-Mechanical System Integration"
- [6] Henry Fadillah, Spring 1999, "Modeling and Control of Media Advance System"
- [7] Oguz Eilbol, Fall 1999, "Modeling and Control of Wire Bonding Machines"
- [8] Robert Witman, Spring 2000, "Remote Control for Telemicroscopy"
- [9] Alan Brockman, Spring and Fall 2001, "Design and Rapid Prototyping of the Articulating Purdue Prosthetic Hand"
- [10] Julia Badger, Summer 2001, "Balancing a Rover Robot using a Solid-State Gyro Sensor"
- [11] Paul Roales, Spring 2002, "Mobility and e-Printing"
- [12] Kenji Totsuka, Honor's Thesis, December 2002, "Modeling and Control of an Electro-Hydraulic Manipulator"
- [13] Julia Badger, Fall 2003, "pH Level Regulation for a Hydroponic Growth Chamber"
- [14] Scott Holbert, Spring 2004, "Sensing Glove Interface and Control of the Articulating Purdue Prosthetic Hand"
- [15] Nikhil Bajaj, Summer 2006 (SURF), "Implementation of a Multi-Spectral Camera using a Precision Piezoelectric stage"
- [16] Nikhil Bajaj, Fall 2006, "Modeling of a Piezoelectric Stage for High Speed Scanning in a Multi-Spectral Camera"
- [17] Andi Satiawan, Honor's Thesis, Fall 2006 and Spring 2007, "Modeling and Control of an Voice-Coil Motor Actuated Dynamic Mirror Actuator for Laser Steering"

- [18] Senaka Hearth-Jayakoddy, Fall 2006 and Spring 2007, "Acoustic De-mining"
- [19] Nikhil Bajaj, Summer 2007 (SURF), "Inkjet Functionalization of Micro Sensor Arrays"
- [20] Samik Ghoshal, Summer 2009 (SURF), "Developing a Low Cost Single Board Microcontroller for Mechatronics Applications"
- [21] Roya Akhavain, Summer 2009, "Inkjet Deposition and Patterning of Biological Material"
- [22] Courtney Burke, Summer 2010, "Optimal Calibration Timing for Color Laser Printers"
- [23] Ann Whitney, Spring 2011, "Piezoelectric Driven Dynamic Mirror Actuator"
- [24] Ann Whitney, Summer 2011, "Piezoelectric Driven Dynamic Mirror Actuator"
- [25] Jieyu Lu, Spring 2014, "Instrumentation and Control for Functional Printing"
- [26] Guoxiang Zhao, Spring and Fall 2014, "Instrumentation and Control for Functional Printing"
- [27] Jieyu Lu, Summer 2014 (SURF), "Anti-counterfeiting"
- [28] Kaixin Zhang, Fall 2015, "Simulation of a Bandwidth-limited Real-time Control System"
- [29] Kaixin Zhang, Summer 2016, "Imaging System for Functional Inkjet Printing"
- [30] Anny Du, Spring 2017, "Fore Arm Rehabilitation Apparatus"
- [31] Ahmed Khalil, Spring/Fall 2017 and Spring 2018 "Cellphone Controlled Robot and Social Network"
- [32] Michael Wang, Fall 2017 and Spring 2018, "Cellphone Robotics"

**Outreach and K-12 Education**

- o *Founding Member and Advisor, Purdue FIRST Programs*  
 Advise Purdue student mentors and coordinate with K-12 school partners to inspire and raise the interest and recognition for science, engineering and technology in K-12 students. The vehicle is to organize K-12 students into multi-disciplinary teams that build robots to compete in regional and national competition, the FIRST Robotic Competition. Currently working with 4 local high schools, 30 Lego Robotics (5-8<sup>th</sup> grade) teams, and hosting Boilermaker Regional Competition as well as the Boilermaker Lego League Tournament. Total K-12 student impacted by our activities exceeds 1200 per year.

**TEACHING AND CURRICULUM DEVELOPMENT**

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**Courses Taught**

ME263L Introduction to Design	Spring 08
ME297F First Leadership	Fall 05, 13, Spring 11, 14, Spring and Fall 06, 07, 08, 09, 10, 15, 16, 17
ME297 ASME Design Contest	Spring 10
ME365 Measurement Systems	Fall 96, 10, 14, 15 and Spring 97, 11, 15
ME375 System Modeling and Analysis	Fall 97, 16, Spring 98, 99, 14, 16
ME463 Senior Capstone Design	Spring 04, 06, 07, 09 and Fall 09
ME475 Automatic Control Systems	Spring 03, Fall 06, 17
ME497F FIRST Robotic Advisor Leadership	Spring and Fall 02, 03, Spring 04
ME578 Digital Control	Spring 98, 99, 2000, 01, 02, 03, 07, 08, 09
ME588 (ME597G) Mechatronics	Fall 98, 99, 2000, 01, 02, 03, 05, Spring 10, 11, 17
ME597H Healthcare Product Design	Fall 07, 08
ME597P Perception-Based Engineering	Spring 09
ME597 Digital Control	Summer 10
EE495M Student Projects in Mobility	Spring and Fall 02, 03, 04, Spring 05
ME497G GEARE Global Design Project	Spring 05 (Shanghai Jiao Tong University), Fall 05, 06, 08, 09, 10 (Purdue University)

**Curriculum Development**

- *Healthcare Product Design*  
The objective of this project-oriented course is to provide guided experience in a multidisciplinary product-design team (Engineering, Management and Nursing), developing new-product ideas that address “patient needs”; i.e., one that focuses on nursing as the primary customer. The teams will develop a product/ device and determine a business model based on clinical needs, market analysis, patient safety, and engineering feasibility studies. The project will emphasize problem-definition, design-conceptualization, and establish a business model.
- *Remote Laboratory*  
The laboratory facility can be accessed through e-mail exchange. This avoided the issues with corporate firewall. The facility provided the student with the flexibility of being able to perform measurement and control experiments anytime and anywhere. It was first deployed during the spring 2002 semester with the ME578 Digital Control course. Student response is exceptionally positive. The facility is currently being duplicated at the University of Michigan. It was used for the first time in Purdue Continuing Engineering Education course to incorporate laboratory and experiment experience into distance learning.
- *FIRST Leadership Course*  
Developed hand-on leadership training course for student mentors of the Purdue FIRST program (PFP). The course is designed to provide students with leadership and mentor skill through the integration of experiential learning and community service. The students practice their leadership, teamwork and mentoring skills through the day-to-day operation of the PFP and all of the programs and events that the organization sponsor and support. The course is organized as a curriculum style format with required session that are fundamental and required for all members of PFP and a set of elective session that the members and select based on their interest and responsibility of in the organization.
- *ME588 (ME597G) Mechatronics*  
A new course developed with an integrated laboratory component. The project-oriented course is intended to provide student with working experience interfacing and power electronics as well as realistic product development experience. The final course project was to simulate actual product development cycle with well-defined deliverable and hard time and resource constraint. Since its first offering in Fall 1998, the course has received an average review of 4.6/5.0 and are attended to capacity, that is limited by laboratory resource constraint. The course model and material has been duplicated to many universities in the US and abroad through Purdue graduates that have taken on academic careers.
- *ME578 Digital Control*  
The course was not offered for many years due to lack of student participation. Professor Chiu completely revamped the course content and instruction format. The course notes and lecture slides are collaboratively developed with Professor H. Peng and were being used by University of Michigan and Purdue University. The course has been offered yearly with increasing enrollment and improved student evaluation. It is also offered through the Purdue distance learning channels.
- *Measurement Systems and ME375 System Dynamics*  
Developed electronic lecture notes that can be continuously updated.

**SERVICE ACTIVITIES**

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**Purdue University – College of Engineering**

- ◆ Data Science and Engineering Committee, 2017-present

- ◆ Diversity and Inclusion Education Team, 2017
- ◆ Global Engineering Program Council, 2014-2017
- ◆ Global Engineering Program Team, 2009 - 2011
- ◆ Perception-based Engineering (PBE) Signature Area Co-Chair, 2009 - 2011
- ◆ Perception-based Engineering (PBE) Faculty Search Committee Co-Chair, 2009 - 2011
- ◆ CoE Strategic Plan Execution Team, 2009 - 2010
- ◆ Global Engineering Program Director Search Committee, 2007 - 2008
- ◆ P-16 Outreach Coordinator Search Committee, 2007 - 2008
- ◆ ICPT Signature Area Search Committee, 2003 - 2006
- ◆ CoE Dean Search Committee, 2000 - 2001
- ◆ Caterpillar/Purdue/MSOE Electro-Hydraulic Education Committee, 1998 - 2002

### **Purdue University - School of Mechanical Engineering**

- ◆ ME Primary Committee, 2005 - present
- ◆ Chair, ME Global Studies and Engagement Committee, 2014-2017
- ◆ ME Leadership Team, 2008 - 2011, 2014-2017
- ◆ School Impact and Reputation Ad-hoc Committee, 2014
- ◆ Faculty Search Committee, member, 2013 - 2015
- ◆ Systems, Measurements and Control (SMAC) Area Chair, 2010 - 2011
- ◆ Facilities Planning and Space Management Committee, 2010 - 2011
- ◆ Spira Lab Faculty Committee Chair, 2000 - 2011
- ◆ Instructional Lab Committee, 1998 - 2011
- ◆ Graduate Committee, 2005 - 2009
- ◆ Internal Academic Review Committee, 2004 - 2005
- ◆ Strategic Faculty Search Committee, 2002 - 2007
- ◆ Mechanical Systems Faculty Search Committee, 2002 - 2003
- ◆ Herrick Lab Academic Planning Committee, 2000 - 2001
- ◆ Ad Hoc Committee on Teaching Load, 1999
- ◆ Herrick Lab Shop Staff Search Committee, 1998 - 1999
- ◆ Feddersen Chair Professor Search Committee, 1998 - 2002

### **Professional Societies and Activities**

- ◆ Fellow of the American Society of Mechanical Engineers (ASME)
- ◆ Fellow of the Society for Imaging Science and Technology (IS&T)
- ◆ Senior Member of Institute of Electrical and Electronic Engineers (IEEE)
- ◆ Member, Board of Directors, American Automatic Control Counsel, 2018-present
- ◆ Member, Nominating Committee, American Automatic Control Counsel, 2016-present
- ◆ Member, International Federation of Automatic Control (IFAC) Technical Committee on Mechatronic Systems, 2005-present
- ◆ Past Chair, ASME Dynamic Systems and Control Division, 2014-2015

- ◆ Chair, Executive Committee, ASME Dynamic Systems and Control Division, 2013-2014
- ◆ Vice Chair, Executive Committee, ASME Dynamic Systems and Control Division, 2012-2013
- ◆ Member, Executive Committee, ASME Dynamic Systems and Control Division, 2010-2012
- ◆ Chair, Management Committee, *IEEE/ASME Transactions on Mechatronics*, 2011
- ◆ Member, Management Committee, *IEEE/ASME Transactions on Mechatronics*, 2010
- ◆ Secretary, ASME Dynamic Systems and Control Division, 2007-2010
- ◆ Conference Committee Chair, Mechatronics Technical Committee, ASME Dynamic Systems and Control Division, 2006-2008
- ◆ Chair, Adaptive and Optimal Control Technical Panel, ASME Dynamic Systems and Control Division, 2002-2004
- ◆ National Committee for Information Technology Standards (NCITS)
  - W1.1 Workgroup – Image Quality for Printers, 2001-2003
- ◆ Vice-Chair, Adaptive and Optimal Control Technical Panel, ASME Dynamic Systems and Control Division, 2000-2002

### **Journal and Publication Editorship**

- ◆ Editor-in-Chief, *IEEE/ASME Transactions on Mechatronics*, 2017-present
- ◆ Member, Editorial Board, *Chinese Journal of Mechanical Engineering*, 2013-present
- ◆ Editor-in-Chief Elect, *IEEE/ASME Transactions on Mechatronics*, 2016
- ◆ Editor, *Journal of Imaging Science and Technology*, 2012-2014
- ◆ Associate Editor, *Journal of Control Engineering Practice*, 2007-2013
- ◆ Member, Editorial Board, *Frontiers of Mechanical Engineering*, 2008-2011
- ◆ Associate Editor, *Journal of Electronic Imaging*, 2005-2011
- ◆ Associate Editor, *ASME Journal of Dynamic Systems, Measurement and Control*, 2004-2009
- ◆ Member, Editorial Board, *Microsystem Technologies – Micro- and Nanosystems. Information Storage and Processing Systems*, 2002-2008
- ◆ Guest Editor, Focused Sections on Healthcare Mechatronics, *IEEE/ASME Transactions on Mechatronics*, April 2010

### **Conference Organization**

- ◆ General Chair, The 2021 American Control Conference
- ◆ Program Chair, The 2016 American Control Conference, Boston, Massachusetts, June 2016
- ◆ Member, Program Committee, 2015 IEEE Multi-conference on Systems and Control, Sydney, Australia, September 2015
- ◆ Member, Organized Session Committee, 2015 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics, Busan, South Korea, July 2015
- ◆ Registration Chair, The 2012 American Control Conference, Montreal, Canada, June 2012
- ◆ Finance Chair, The 2011 American Control Conference, San Francisco, California, June 2011
- ◆ Member, Program Committee, The 49th IEEE Conference on Decision and Control (CDC10), Atlanta, Georgia, November 2010
- ◆ Publication Chair, The 2010 Dynamic Systems and Control Conference (DSCC10), Boston, Massachusetts, October 2010

- ◆ Publication Chair, The 2010 IFAC Symposium on Mechatronic Systems, Boston, Massachusetts, October 2010
- ◆ Program Chair, The 2010 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics (AIM'10), Montreal, Canada, July 2010
- ◆ Publicity Chair, The 2009 ASME Dynamic Systems and Control Conference (DSCC09), Los Angeles, California, October 2009
- ◆ Program Chair - Special Papers, The 25<sup>th</sup> International Conference on Digital Printing Technologies, Louisville, Kentucky, September 2009
- ◆ Program Co-Chair, The 2009 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics (AIM'09), Singapore, July 2009
- ◆ Publicity Chair, The 2008 ASME Dynamic Systems and Control Conference (DSCC08), Ann Arbor, Michigan, October 2008
- ◆ Panel Moderator, "Environmental and Reliability Challenges for Electrophotographic and Ink Jet Printing," The 24<sup>th</sup> International Conference on Digital Printing Technologies, Pittsburg, Pennsylvania, September 10, 2008.
- ◆ Organizing Co-Chair, The 2008 IEEE International Conference on Automation and Logistics, Qingdao, China, September 2008
- ◆ Member, Organizing Committee, The 2007 International Automatic Control Conference (CAC2007), Taichung, Taiwan, November 2007
- ◆ Member, International Program Committee, The 2007 International Conference on Advanced Intelligent Mechatronics (AIM'07), Zurich, Switzerland, September 2007
- ◆ Member, International Program Committee, The 4<sup>th</sup> International Federation of Automatic Control (IFAC) Symposium on Mechatronic Systems, Heidelberg, Germany, September 2006
- ◆ Member, Program Committee, The 2006 International Symposium on Flexible Automation, Osaka, Japan, July 10-12, 2006
- ◆ Member, Organizing Committee, The 16th Joint ASME Symposium on Information Storage and Processing Systems and the JSME MIPE, Santa Clara, California, June 2006
- ◆ Member (ASME Representative), Program Committee, The 2006 American Control Conference, Minneapolis, Minnesota, June 2006
- ◆ Workshop/Tutorial Chair, The 2005 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics (AIM'05), Monterey, California, July 2005
- ◆ Member, International Program Committee, The 3<sup>rd</sup> International Federation of Automatic Control (IFAC) Symposium on Mechatronic Systems, Manly, Australia, September 2004
- ◆ Member, Organizing Committee, The 14th ASME Annual Symposium on Information Storage and Processing Systems, Santa Clara, California, June 2004
- ◆ Member, Program Committee, The 2004 American Control Conference, Boston, Massachusetts, June 2004
- ◆ Member, Program Committee, The 2003 IEEE/ ASME International Conference on Advanced Intelligent Mechatronics (AIM'03), Kobe, Japan, July 2003
- ◆ Member, International Program Committee, The 2<sup>nd</sup> International Federation of Automatic Control (IFAC) Symposium on Mechatronic Systems, Berkeley, California, December 2002
- ◆ Member, Technical Committee, The 2002 IEEE International Symposium on Industrial Electronics (ISIE 2002), L'Aquila, Italy, 2002

- ◆ Member, Organizing Committee, The 13th Annual Symposium on Information Storage and Processing Systems, Santa Clara, California, June 2002
- ◆ Member, Program Committee, The 2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM'01), Como, Italy, July 2001
- ◆ Member, Organizing Committee, The 12th Annual Symposium on Information Storage and Processing Systems, Santa Clara, California, June 2001
- ◆ Session Organizer/Chair for:
  - Session Chair, "Estimation and Identification," 2016 ASME Dynamic Systems and Control Conference, October 2016
  - Session Chair, "Mechatronics," 2015 ASME Dynamic Systems and Control Conference, October 2015
  - Session Chair, "Control of Mechatronic Systems," 2014 ASME Dynamic Systems and Control Conference, October 2014
  - Session Chair, "Sensors and Sensing Systems," 2013 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, July 2013
  - Session Co-Chair, "Modeling and Design of Mechatronic Systems 2," 2012 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, July 2012
  - Session Chair, "Modeling and Simulation," 2011 ASME Dynamic Systems and Control Conference, October-November 2011
  - Session Co-Chair, "Microelectromechanical Systems (MEMS)," 2010 ASME Dynamic Systems and Control Conference, September 2010
  - Session Chair, "Modeling and Design of Mechatronic Systems III," 2009 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, July 2009
  - Session Organizer/Chair, "Imaging and Printing Technologies," 2009 JSME/ASME Joint Conference on Micromechatronics for Information and Precision Equipment (MIPE), June 2009
  - Session Chair, "Optimal and LPV Control," 2008 ASME Dynamic Systems and Control Conference, Ann Arbor, Michigan, October 2008
  - Session Chair, "Human Motion Modeling and Control," 2008 ASME Dynamic Systems and Control Conference, Ann Arbor, Michigan, October 2008
  - US Chair, "Printing Systems Engineering and Optimization," NIP24: International Conference on Digital Printing Technologies, Pittsburg, Pennsylvania, September 2008
  - Session Chair, "Applications of Nonlinear Control - II," 2008 IFAC World Congress, Seoul, South Korea, July 2008
  - Session Chair, "Nonlinear and Adaptive Control I," 2008 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Xian, China, July 2008
  - Topic Organizer, "Mechatronics," 2007 ASME International Mechanical Engineering Congress and Exposition, Seattle, Washington, November 2007
  - US Chair, "Printing Systems Engineering and Optimization," NIP23: International Conference on Digital Printing Technologies, September 2007
  - Session Chair, "Robust Control and Applications," 2007 American Control Conference, July 2007
  - Session Chair, "Metrology and Control," 2007 International Conference on Integration and Commercialization of Micro and Nanosystems, Sanya, China, January 2007
  - Topic Organizer, "Mechatronics," 2006 ASME International Mechanical Engineering Congress and Exposition, Chicago, Illinois, November 2006
  - US Chair, "Printing Systems Engineering/Optimization," NIP22: International Conference on Digital Printing Technologies, September 17-22, 2006
  - Chair, "Digital Filtering and Embedded Control," the 4th IFAC-Symposium on Mechatronic Systems, Heidelberg, Germany, September 12-14, 2006



- Co-Chair, "Innovative Production Systems and Control," 2006 International Symposium on Flexible Automation, Osaka, Japan, July 10-12, 2006
- Co-organizer/Co-Chair, "Image Construction Technology," 2006 ASME/JSME Joint Conference on Micromechatronics for Information and Precision Equipment, Santa Clara, California, June 21-23, 2006
- Co-Chair, "Modeling for Emerging Applications," 2006 American Control Conference, Minneapolis, Minnesota, June 14-16, 2006
- Co-Chair, "Control of Mechatronic Systems," The 3<sup>rd</sup> IFAC Symposium on Mechatronic Systems, Sydney, Australia, September 2004
- Organizer/Chair, "Sensing, Modeling and Control of Xerography," 2004 American Control Conference, Boston, Massachusetts, July 2004
- Chair, "Control Applications," 2003 IEEE International Conference on Robotics and Automation, Taipei, Taiwan, September 2003
- Chair, "Adaptive Control for Electro-Mechanical Systems," 2003 American Control Conference, Denver, Colorado, June 2003
- Chair, "Vision Systems," 2<sup>nd</sup> IFAC Conference on Mechatronic Systems, Berkeley, California, December 2002
- Chair, "Motion Control," 2<sup>nd</sup> IFAC Conference on Mechatronic Systems, Berkeley, California, December 2002
- Chair, "Nonlinear Control," 2<sup>nd</sup> IFAC Conference on Mechatronic Systems, Berkeley, California, December 2002
- Organizer/Chair, "Symposium on the Theory and Applications of Adaptive and Optimal Control," 2002 ASME International Mechanical Engineering Congress and Exposition, New Orleans, Louisiana, November 2002
- Chair, "Electric Motors and Electronics," the 16<sup>th</sup> International Compressor Engineering and the 9<sup>th</sup> International Refrigeration and Air Conditioning Conferences, West Lafayette, Indiana, July 2002
- Chair, "Control Applications III," 2002 American Control Conference, Anchorage, Alaska, May 2002
- Organizer/Chair, "Identification of Mechanical Systems," 2001 ASME International Mechanical Engineering Congress and Exposition, New York, New York, November 2001
- Organizer/Chair, "Advance in Adaptive and Optimal Control," 2001 ASME International Mechanical Engineering Congress and Exposition, New York, New York, November 2001
- Chair, "Software Design for Manufacturing," 2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM '01), Como, Italy, July 2001
- Organizer/Chair, "Motion and Imaging," 2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM '01), Como, Italy, July 2001
- Organizer/Chair, "Motion and Imaging," 2000 ASME International Mechanical Engineering Congress and Exposition, Orlando, Florida, November 2000
- Organizer/Chair, "Recent Advances in Adaptive and Optimal Control," 2000 ASME International Mechanical Engineering Congress and Exposition, Orlando, Florida, November 2000
- Organizer/Chair, "Control of Electro-Mechanical Systems," 2000 American Control Conference, Chicago, June 2000
- Chair, "Intelligent Systems Applications," 2000 American Control Conference, Chicago, June 2000
- Organizer/Chair, "Coordinated Control," 1999 American Control Conference, San Diego, June 1999

- Co-Chair, "Historical Perspective, Landmark Results, and Future Research Directions in Robust Control," 1998 ASME International Mechanical Engineering Congress and Exposition, Anaheim, November 1998
- Co-Chair, "Flexible Media Mechanics," 1998 ASME International Mechanical Engineering Congress and Exposition, Anaheim, November 1998
- Organizer/Chair, "Coordinated Control," 1998 American Control Conference, Philadelphia, June 1998
- Organizer/Chair, "Control of Electro-Hydraulic Systems," 1998 American Control Conference, Philadelphia, June 24 - 26, 1998
- Co-Chair, "Design and Control of Smart Machines," 1997 ASME International Mechanical Engineering Congress and Exposition, Dallas, November 1997
- ◆ Reviewer for:
  - Hong Kong University of Science and Technology, Central Research Facility Review Panel, Chair, 2018
  - University of Cincinnati, Mechanical Engineering Graduate Program, External reviewer, 2017
  - Hong Kong Innovation and Technology Council, Partner State Key Lab Review Panel, 2017
  - SUNY Plattsburgh, Robotics Program, External reviewer, 2017
  - Hong Kong Research Grant Council, Engineering Subpanel, member, 2016-present
  - Oklahoma State University, Mechanical and Aerospace Engineering, External reviewer, 2016
  - National Science Foundation
  - Canadian Council for the Arts
  - ASME Journal of Dynamic Systems, Measurement and Control
  - ASME Journal of Manufacturing Science and Engineering
  - IEEE/ASME Transactions on Mechatronics
  - IEEE Transactions on Automatic Control
  - IEEE Transactions on Control Systems Technology
  - IFAC Journal on Mechatronics
  - IFAC Journal of Control Engineering Practice
  - IEEE Transactions on Education
  - IEEE Control Systems Magazine
  - Journal of Sound and Vibration
  - Journal of Electronic Imaging
  - Microsystem Technologies - Micro- and Nanosystems and Information Storage and Processing Systems
  - Automatica
  - European Journal of Control
  - International Journal on Optimal Control and Applications
  - U.S. Civilian Research & Development Foundation
  - Various national and international conferences in control and mechatronics
  - Prentice-Hall, McGraw-Hill, and PWS Publishing Company

## **SHORT COURSES**

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- [1] "Topics on Robust Control," - Harbin Institute of Technology, March 28-31, 2011
- [2] "Modeling and Control of Digital Imaging and Printing Systems," - Harbin Institute of Technology, June 23-25, 2009
- [3] "Topics on Digital Control," - Zhejiang University, November 10-19, 2008

- [4] "Digital Control and Applications for Mechatronic Systems" - Japan-USA-Vietnam RESCCE 2002 Summer School
- [5] "Automatic Control" - Herrick Laboratories Partners Program Short Course (with M. Franchek)
- [6] "Basic Controls" - Caterpillar Electrohydraulic Curriculum
- [7] "Fundamentals of Microprocessor Control" - Herrick Laboratory Short Course (with P. Meckl)

## **CONSULTING**

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General Vibration LLC; Bracewell LLP; Stryker; Fitzpatrick, Cella, Harper & Scintos LLP; Shuttleworth Inc.; SiPix Inc.; Indiana University; Ingersoll-Rand; Caterpillar; Unisys; Texas Instruments; and The Applied Group

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## **RESEARCH AND CURRICULUM GRANTS AND CONTRACTS**

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Total GC Share: \$ 7,285,557.67= \$1,844,520.99 (as PI) + \$ 5,441,036.68 (as Co-PI)  
Total involved: 90 grants/contracts more than \$48 million.