

Dhananjay Anand

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RESEARCH INTERESTS Distributed control, Power systems, Embedded control, Modeling of dynamic systems, Simulation, Mechatronics and Optimization.

EDUCATION **University of Michigan**, Ann Arbor, Michigan

Ph.D., Mechanical Engineering, April 2013

- Dissertation title: Semantic networks for hybrid processes.
- Advisers: Professor Dawn Tilbury and Dr. James Moyne

M.S., Mechanical Engineering, December 2008

- Summa Cum Laude *GPA*: 4.00/4.00 (converted from a 9.0 scale)
- Area of Specialization: Dynamics and Control
- Guided research topics: Performance of wireless networks for industrial automation, Data analysis on transient diesel engine soot emissions.
- Advisers: Professor Dawn Tilbury, Dr. James Moyne and Professor Jeffrey Stein

B.S., Visvesvaraya Technological University, Mechanical Engineering, June 2004

- Graduating grade: *First class* (With Distinction)
- Design specialization (emphasis on machine design and manufacturing systems)
- Minor in Control systems

ACADEMIC EXPERIENCE **University of Michigan**, Ann Arbor, MI

Post-doctoral researcher

April 2013 to July 2013

- Developed distributed control and consensus strategies for the coordinated charging of electric vehicles.
- Helped design a testbed to demonstrate information driven reconfigurable manufacturing.

Graduate Student Research Assistant

January 2008 to April 2013

- Graduate student researcher with the NSF Engineering Research Center for Reconfigurable Manufacturing Systems and the Ground Robotics Reliability Center.
- Funded by the United States Consortium for Automotive Research (USCAR) from 2008 to 2010 and the National Institute of Standards and Technology (NIST) from 2010 to 2013.
- Studied model adaptation and estimation problems in large-scale distributed applications.
- Developed simulation and diagnosis methods for applications in manufacturing and power systems.
- Studied Ethernet based clock synchronization for semiconductor fabrication facilities and distributed control of power systems.
- Designed a control testbed to investigate state estimator coordination using precise clocks and time synchronization.
- Responsible for collaborative study on wireless network performance when used for factory automation.
- Developed test cases for industrial wireless validation in conjunction with the Underwriters Laboratories.

Visiting scholar at Lund University

May 2011

(Center for Control of Complex Engineering Systems, Lund University, Sweden)

- Invited to the Focus Period on Dynamics, Control and Pricing in Power Systems.
- Developed competence in object oriented modeling of cyber-physical systems.

PUBLICATIONS

- D. M. Anand**, K.P. Olikara, J. Moyne and D.M., Tilbury, Coordinated Charging of Plug-In Electric Vehicles Using Distributed Incentive Arbitration *IEEE Transactions of Smart Grid* (Special Issue), 2013. Submitted.
- D. M. Anand**, J. Moyne and D.M., Tilbury, Efficient diagnostic analysis of manufacturing process workflows. *IEEE Transactions of Semiconductor manufacturing*, 2013. Accepted.
- J. Moyne, D. M. Tilbury, **D. M. Anand** “Networked Control Systems for Manufacturing”, in *Embedded Systems Handbook: Embedded Systems Design and Verification*, Second Edition. NY: CRC Press, 2013.
- D. M. Anand**, J. Moyne and D.M., Tilbury. Isolating yield discrepancies in a manufacturing process workflow *In Proc AEC/APC Symposium*, 2012.
- D. M. Anand**, J. Moyne, D. M. Tilbury. Running simulation models in parallel with physical systems for improved estimation performance: Semantic models facilitate updating model State, Parameters, and Structure. *In Proc. ASME DSCC*, 2011.
- D. M. Anand**, J.G. Fletcher, Y. Li-Baboud and J. Moyne. Using clock accuracy to guide model synthesis in distributed systems: An application in power grid control. *In Proc. IEEE ISPCS*, 2010.
- D. M. Anand**, J.G. Fletcher, Y. Li-Baboud and J. Moyne. A practical implementation of distributed system control over an asynchronous Ethernet network using time stamped data. *In Proc. IEEE CASE*, 2010.
- D. M. Anand**, J. Moyne, and D.M. Tilbury. Performance evaluation of wireless networks for factory automation applications *In Proc. IEEE CASE*, 2009.
- D. M. Anand**, D. Sharma, Y. Li-Baboud and J. Moyne. Timing performance and time synchronization over a wireless network: Analysis, experimentation and application to semiconductor manufacturing. *In Proc. IEEE ISPCS*, 2009.
- J. Amelot, **D. M. Anand**, T. Nelson, G. Stenbakken, Y. Li-Baboud and J. Moyne. Towards timely intelligence in the power grid. *In Proc. PTTI Systems and Applications Meeting*, 2012.
- J. Amelot, Y. Li-Baboud, J. Fletcher, **D. M. Anand** and J. Moyne. An IEEE 1588 Performance Testing Dashboard for Power Industry Requirements. *In Proc. PerMIS*, 2012.
- J. Fletcher, **D. M. Anand**, M.Chaluvadi and J. Moyne. Smart clocks have a hand in the Smart Grid *In Proc. IEEE-PES General Meeting*, 2011.
- J. Amelot, C. Vasseur, Y. Li-Baboud, J.G. Fletcher. **D. M. Anand** and J. Moyne. An IEEE 1588 Time Synchronization Testbed for assessing power distribution requirements. *In Proc. IEEE ISPCS*, 2010.
- D. Sharma, **D. M. Anand**, Y Li-Baboud and J. Moyne. A Time Synchronization Testbed to Define and Standardize Real-Time Model-Based Control Capabilities in Semiconductor Manufacturing. *In Proc AEC/APC Symposium*, 2009.
- Ya-Shian Li-Baboud, X. Zhu, **D. M. Anand**, S. Hussaini, and J.R. Moyne. Semiconductor manufacturing equipment data acquisition simulation for timing performance analysis. *In Proc. IEEE ISPCS*, 2008.

PROFESSIONAL
EXPERIENCE

National Institute of Standards and Technology, Gaithersburg, MD **July 2013 to Present**

Research Scientist

- Visiting lecturer: University of Maryland
- Cyber-Infrastructure Group in the Information Technology Laboratory
- Secure Industrial Control Systems Group in the Intelligent Systems Division
- Precision timing and Transactive energy systems at the NIST Smart Grid Testbed Facility

Palo Alto Research Center, Palo Alto, CA **June 2011 to September 2011**

Research Intern

- Worked in the Embedded Reasoning Area of the Intelligent Systems Laboratory (ERA/ISL).
- Developed control algorithms as part of a large project to improve the design methodology used for complex cyber-physical systems.
- Developed a qualitative simulation tool to analyze the control performance of dynamic electro-mechanical systems.

National Institute of Standards and Technology, Gaithersburg, MD **Summer 2010**

Guest Researcher

- Worked with the Electrical Engineering and Electronics Laboratory.
- Electronics and network topology design for an experiment measuring the performance of network clock synchronization and sensitivity to Ethernet traffic (mixed signal measurement and Ethernet traffic profile generation).

Palo Alto Research Center, Palo Alto, CA **June 2009 to August 2009**

Research Intern

- Worked in the Embedded Reasoning Area of the Intelligent Systems Laboratory (ERA/ISL).
- Contributed to the design of a prototype reconfigurable/flexible manufacturing system.
- Involved with electronic hardware design, mechanical design and simulation studies.

Raman Research Institute, Bangalore, India **August 2004 to September 2007**

Engineer –Controls and Systems

- Involved with mechanical engineering and design of space based instrumentation.
- Designed power electronics and control hardware associated with electric marine propulsion, navigation and control.
- Led an engineering crew aboard a research vessel during extended deep sea trials.

MICO-Bosch Ltd., Bangalore, India **January 2004 to July 2004**

Trainee Engineer –Automation Track

- Worked in *Bosch Research and Machine Building Section*.
- Designed fixtures and in-line inspection hardware for CNC machining centers.
- Designed automated quality control operations for diesel injector assemblies.

ACHIEVEMENTS Invited Paper APC Conference, 2012
Best Student Paper IEEE-ISPCS, 2010
Tau Beta Pi Engineering Honor Society, University of Michigan, 2008–present

SERVICE & EXTRACURRICULAR ACTIVITIES Research Mentorship Award –Under graduate research opportunities program (UROP)
Substitute Instructor EECS560-Linear Systems Theory
Peer Reviewer for IEEE- CASE, TASE, ICRA, ISPCS and ACC.
Hobby electronics and mechatronics projects.

TECHNICAL SKILLS Hardware and software experience in Control Engineering, Modeling & Simulation, Electronic systems design and Mechanical design.
Analytical experience in control systems design and theory, nonlinear dynamics, system identification, modeling and simulation of electro-mechanical systems.
Programming: MATLAB, C, C++, JAVA