Scott J. Moura, Ph.D.

Mechanical & Aerospace Engineering
University of California, San Diego
smoura@ucsd.edu
http://flyingv.ucsd.edu/smoura

Cymer Center for Control Systems & Dynamics
Office: 1801 EBU I
9500 Gilman Drive #0411
San Diego, CA USA 92093-0411
Tel: +1 (818) 395-5718

Education

President's Postdoctoral Fellow (2011-2013) **University of California, San Diego**
Topic: *PDE Control and Estimation Techniques for Advanced Battery Management Systems*
Advisor: Professor Miroslav Krstić
Major Field: Systems and Controls

Ph.D., Mechanical Engineering (2011) **University of Michigan, Ann Arbor**
Dissertation: *Techniques for Battery Health Conscious Power Management via Electrochemical Modeling and Optimal Control*
Advisors: Professor Jeffrey L. Stein (Michigan) and Professor Hosam K. Fathy (Penn State)
Committee: Prof. Jeffrey Stein (Michigan-ME), Prof. Hosam Fathy (Penn State-MNE), Prof. Huei Peng (Michigan-ME), Prof. Jessy Grizzle (Michigan-EECS:Systems)
Major Field: Systems and Controls

M.S.E, Mechanical Engineering (2008) **University of Michigan, Ann Arbor**
Thesis: *Plug-in Hybrid Electric Vehicle Power Management: Optimal Control & Battery Sizing*
Advisors: Professor Jeffrey L. Stein (Michigan), Professor Hosam K. Fathy (Penn State), and Professor Duncan S. Callaway (UC Berkeley)
Major Field: Systems and Controls

B.S., Mechanical Engineering (2006) **University of California, Berkeley**
Graduated with Honors

Research Interests

Optimal control, PDE control, stochastic control, adaptive control, dynamic system modeling, energy storage/conversion systems, advanced battery systems, vehicle electrification, smart grid systems.

Publications & Presentations

Peer-Reviewed Journals (Accepted)

J1. S. J. Moura, H. K. Fathy, D. S. Callaway, and J. L. Stein, "A Stochastic Optimal Control Approach for Power Management in Plug-in Hybrid Electric Vehicles," *IEEE Transactions on Control Systems Technology*, v 19, n 3, p 545-555, May 2011.

J2. S. J. Moura, D. S. Callaway, H. K. Fathy, and J. L. Stein, "Impact of Battery Sizing on Stochastic Optimal Power Management in Plug-in Hybrid Electric Vehicles," *Journal of Power Sources*, v 195, n 9, p 2979-2988, May 2010.

J3. S. Bashash, S. J. Moura, J. C. Forman, and H. K. Fathy, "Plug-in hybrid electric vehicle charge pattern optimization for energy cost and battery longevity," *Journal of Power Sources*, v 196, n 1, p 541-549, January 2011.

J4. S. J. Moura, J. C. Forman, S. Bashash, J. L. Stein, and H. K. Fathy, "Optimal Control of Film Growth in Lithium-Ion Battery Packs via Relay Switches," *IEEE Transactions on Industrial Electronics*, v 58, n 8, p 3555-3566, Aug 2011.

J5. S. Bashash, S. J. Moura, and H. K. Fathy, "On the Aggregated Grid Load Imposed by Battery Health-Conscious Charging of Plug-in Hybrid Electric Vehicles," *Journal of Power Sources*, v 196, n 20, p 8747-8754, Oct 2011.

J6. S. J. Moura, J. L. Stein, and H. K. Fathy, "Battery Health Conscious Power Management in Plug-in Hybrid Electric Vehicles via Electrochemical Modeling and Stochastic Control," *IEEE Transactions on Control Systems Technology*, to appear.

Peer-Reviewed Journals (In Review)

J7. S. J. Moura and Y. A. Chang, "Lyapunov-Based Switched Extremum Seeking for Maximum Power Point Tracking in Photovoltaic Systems," (in review).

J8. J. C. Forman, S. J. Moura, J. L. Stein, H. K. Fathy, "Genetic Identification and Fisher Identifiability Analysis of the Doyle-Fuller-Newman Model from Experimental Cycling of a $LiFePO_4$ Cell" (in review).

J9. S. J. Moura and H. K. Fathy, "Optimal Boundary Control of Reaction-Diffusion PDEs via Weak Variations," (in review).

Peer-Reviewed Journals (In Preparation)

J10. S. J. Moura, N. A. Chaturvedi, M. Krstic, "Adaptive PDE Observer for Battery SOC/SOH Estimation," (in preparation).

J11. H. K. Fathy, S. J. Moura, S. Bashash, and R. Patil, "Plug-in Hybrid Electric Vehicle Power Management for Vehicle-to-Grid Integration," (in preparation for textbook publication).

J12. P. Wolfes, S. J. Moura, and M. Krstic, "Optimal Sensor Placement for Spatio-temporal Temperature Estimation in Large Battery Packs," (in preparation)

Conferences Proceedings (Accepted)

C1. S. J. Moura, H. K. Fathy, D. S. Callaway, J. L. Stein, "A Stochastic Optimal Control Approach for Power Management in Plug-in Hybrid Electric Vehicles," *Proceedings of the 2008 ASME Dynamic Systems and Control Conference*, Ann Arbor, MI, 2008.

C2. S. J. Moura, D. S. Callaway, H. K. Fathy, and J. L. Stein, "Impact of Battery Sizing on Stochastic Optimal Power Management in Plug-in Hybrid Electric Vehicles," *Proceedings of the 2008 IEEE International Conference on Vehicular Electronics and Safety*, pp. 96-102, Columbus, OH, 2008. (Invited Paper)

C3. Y. A. Chang, S. J. Moura, "Real-Time Air-Flow Control in Fuel Cell Systems: An Extremum Seeking Approach," *Proc. of the 2009 American Control Conference*, St. Louis, MO, 2009.

C4. S. J. Moura, J. C. Forman, J. L Stein, H. K. Fathy, "Control of Film Growth in Lithium Ion Battery Packs via Switches," *Proceedings of the 2009 ASME Dynamic Systems and Control Conference*, Hollywood, CA, 2009. **Best Student Paper Finalist**

C5. S. J. Moura, Y. A. Chang "Asymptotic Convergence through Lyapunov-Based Switching in Extremum Seeking with Application to Photovoltaic Systems," *Proceedings of the 2010 American Control Conference*, Baltimore, MD, 2010.

C6. S. Bashash, S. J. Moura, H. K. Fathy "Charge Trajectory Optimization of Plug-in Hybrid Electric Vehicles for Energy Cost Reduction and Battery Life Enhancement," *Proceedings of the 2010 American Control Conference*, Baltimore, MD, 2010.

C7. S. J. Moura, J. B. Siegel, D. J. Siegel, H. K. Fathy, A. G. Stefanopoulou, "Education on Vehicle Electrification: Battery Systems, Fuel Cells, and Hydrogen," *Proceedings of the 2010 IEEE Vehicle Power and Propulsion Conference*, Lille, France, 2010.

C8. S. J. Moura, J. L. Stein, H. K. Fathy, "Battery Health-Conscious Power Management for Plug-in Hybrid Electric Vehicles via Stochastic Control," *Proceedings of the 2010 ASME Dynamic Systems and Control Conference*, Cambridge, MA, 2010.

C9. S. Bashash, S. J. Moura, H. K. Fathy, "Battery Health-Conscious Plug-in Hybrid Electric Vehicle Power Demand Prediction," *Proceedings of the 2010 ASME Dynamic Systems and Control Conference*, Cambridge, MA, 2010.

C10. S. J. Moura, H. K. Fathy, "Optimal Boundary Control & Estimation of Diffusion-Reaction PDEs," *Proceedings of the 2011 American Control Conf.*, San Francisco, CA, 2011. **Best Student Paper Finalist**

C11. J. C. Forman, S. J. Moura, J. L. Stein, H. K. Fathy, "Genetic Parameter Identification of the Doyle-Fuller-Newman Model From Experimental Cycling of a Li-ion $LiFePO_4$ Battery," *Proceedings of the 2011 American Control Conference*, San Francisco, CA, 2011.

C12. S. J. Moura, N. A. Chaturvedi, M. Krstic "PDE Estimation Techniques for Advanced Battery Management Systems - Part I: SOC Estimation," *Proceedings of the 2012 American Control Conference*, Montreal, Canada, 2012. (Invited Paper)

C13. S. J. Moura, N. A. Chaturvedi, M. Krstic "PDE Estimation Techniques for Advanced Battery Management Systems - Part II: SOH Identification," *Proceedings of the 2012 American Control Conference*, Montreal, Canada, 2012. (Invited Paper)

Conferences Proceedings (In Preparation)

C14. P. Wolfes, S. J. Moura, M. Krstic, "Optimal Sensor Placement for Spatio-Temporal Temperature Estimation in Large Battery Packs," *Proceedings of the 51st IEEE Conference on Decision and Control*, Maui, HI, 2012. (Invited Paper)

C15. S. J. Moura, N. Chaturvedi, M. Krstic, "Adaptive PDE Observer for Battery SOC/SOH Estimation," *Proceedings of the 2012 ASME Dynamic Systems and Control Conference*, Ft. Lauderdale, FL, 2012. (in preparation)

Invited Talks

- Princeton University (Mar 2012)
  "Optimal Control and Adaptive Estimation in Battery Energy Storage Systems "
- Bosch LLC, Research and Technology Center, Palo Alto, CA (Jan 2012)
  "Adaptive PDE Observer for Battery SOC/SOH Estimation"
- Tesla Motors (Mar 2011)
  "Battery Health Conscious Power Management in Plug-in Hybrid Electric Vehicles via Electrochemical Modeling & Stochastic Control"
- University of Illinois, Urbana-Champaign (Feb 2011)
  "Optimal Control of Lithium-ion Battery Energy Storage Systems"
- California Institute of Technology (Jan 2011)
  "Optimal Control of Lithium-ion Battery Energy Storage Systems"

- Ford Motor Company (Dec 2010)
  "Optimal Control of Lithium-ion Battery Energy Storage Systems"
- Colorado State University (Dec 2010)
  "Optimal Control of Lithium-ion Battery Energy Storage Systems"
- Syracuse University (Nov 2010)
  "Optimal Control of Lithium-ion Battery Energy Storage Systems"

Technical Presentations

- S. J. Moura, H. K. Fathy, D. S. Callaway, and J. L. Stein, "Interaction of Battery Size and Optimal Power Management in Plug-in Hybrid Electric Vehicles," *Automotive Research Center Conference*, Ann Arbor, MI, 2009.
- S. J. Moura, D. S. Callaway, H. K. Fathy, and J. L. Stein, "Plug-in Hybrid Electric Vehicle Power Management: Optimal Control and Battery Sizing," *Society of Hispanic Professional Engineers Conference*, Phoenix, AZ, 2008. **Technical Paper Competition Winner**
- S. J. Moura, D. S. Callaway, H. K. Fathy, and J. L. Stein, "Plug-in Hybrid Electric Vehicle Power Management: Optimal Control and Battery Sizing," *Engineering Graduate Symposium*, Ann Arbor, MI, 2008. **2nd Place Poster, System Analysis and Control Session**
- S. J. Moura, H. K. Fathy, D. S. Callaway, and J. L. Stein, "A Stochastic Optimal Control Approach for Power Management in Plug-in Hybrid Electric Vehicles," *Automotive Research Center Conference*, Ann Arbor, MI, 2008.
- S. J. Moura, H. K. Fathy, D. S. Callaway, and J. L. Stein, "Plug-in Hybrid Powertrain Modeling," *Engineering Graduate Symposium*, Ann Arbor, MI, 2007. **2nd Place Oral Presentation, System Analysis and Control Session**
- S. J. Moura, D. Kum, H. K. Fathy, and J. L. Stein, "Hybrid Powertrain Optimization for Plug-in Microgrid Power Generation," *Automotive Research Center Conference*, Ann Arbor, MI, 2007.

Awards & Honors

University of California Presidential Postdoctoral Fellowship
University of California (2011 - 2012)

National Science Foundation (NSF) Graduate Research Fellowship
National Science Foundation (2008 - 2011)

ProQuest Distinguished Dissertation Award, Honorable Mention
Rackham Graduate School, University of Michigan (2011)

Distinguished Leadership Award
College of Engineering, University of Michigan (2009)

Rackham Merit Fellowship (RMF)
University of Michigan Rackham Graduate School (2006 – 2011)

2011 American Control Conference, San Francisco, CA USA
Best Student Paper Finalist
Best Presentation in Session

2009 ASME Dynamic Systems and Control Conference, Hollywood, CA USA
Best Student Paper Finalist
Best Presentation in Session

2009 American Control Conference, Baltimore, MD USA
Best Presentation in Session

2008 ASME Dynamic Systems and Control Conference, Ann Arbor, MI USA
Best Presentation in Session

2008 Society of Hispanic Professional Engineers Conference, Phoenix, AZ USA
1st Place Technical Paper Competition

2008 Engineering Graduate Symposium, University of Michigan
2nd Place Poster, Control Systems Session

2007 Engineering Graduate Symposium, University of Michigan
2nd Place Oral Presentation, System Analysis and Control Session

Michigan Memorial Phoenix Energy Institute (MMPEI)
MMPEI-Rackham Energy Fellowship, Honorable Mention (2007 – 2008)

SHPE Academic Achievement Award
Society of Hispanic Engineers and Scientists, University of Michigan (2007)

National Science Foundation (NSF)
Graduate Research Fellowship Program (GRFP), Honorable Mention (2006 – 2007)

Christopher A. Burrows Memorial Scholarship
Community Scholarship Foundation (2002)

Paul Rickershauser Memorial Award
Community Scholarship Foundation (2002)

The Governor's Scholars Award
Governor's Scholarship Programs (2001)

Teaching Experience

- MAE 287: Control of Distributed Parameter Systems @ UC San Diego (Fall 2011)
  Guest lecturer on PDE backstepping observers with application to batteries
- ME 499/599: Battery Systems & Control @ U-Michigan (Winter 2011)
  Co-Instructor and co-developer for new course within DOE-ARRA education program
  Enrollment: 50
- ME 499/599: Battery Systems & Control @ U-Michigan (Winter 2010)
  Co-Instructor and co-developer for new course within DOE-ARRA education program
  Enrollment: 59
- Undergraduate Research Assistant Mentor @ U-Michigan (Summer 2010)
  "Li-ion Battery Float Charger Design and Fabrication"
- 10th Grade Preparatory Math (Summer 2005)
  Campbell Academic Services, ACES, Detroit, MI
- Drum Major (Summer 2004)
  Mystikal Drum & Bugle Corps, Newbury Park, CA

Student Supervision

- Philipp Wolf, Univ. of Stuttgart, Diplome (equivalent to Masters)
  "PDE Modeling, Estimation, and Control for Thermal Dynamics in Battery Packs"
- Aaron Stein, Undergraduate @ U-Michigan
  "Li-ion Battery Float Charger Design and Fabrication"

Society Memberships

American Society of Mechanical Engineers (ASME)
Student Member, Dynamic Systems and Control Division (2002 – present)
Institute of Electrical and Electronics Engineers (IEEE)
Student Member, Control Systems Society (2008 – present)
Student Member, Industrial Electronics Society (2010 – present)
Society of Hispanic Professional Engineers (SHPE)
University of Michigan, Student Chapter (2006 – present)
Community Service Committee (Sept. 2007 – present)
UC Berkeley Hispanic Engineers & Scientists, Student Chapter (2002 - 2006)
Administrative Vice-President (2004-2006)

Academic Service

Reviewer

- **Funding Agencies:** National Science Foundation (NSF); Croatian Science Foundation (CSF)
- **Journals:** ASME Journal of Dynamics Systems, Measurement, and Control; Energies; IEEE Trans. on Control Systems Technology; IEEE Trans. on Industrial Electronics; IEEE Trans. on Intelligent Transportation Systems; IEEE/ASME Trans. on Mechatronics; IEEE Trans. on Power Systems; IEEE Trans. on Vehicular Technology; IET Intelligent Transport Systems; International Journal of Electrical Power & Energy Systems; International Journal of Powertrains; Journal of Fluids and Structures; Sensors; Simulation Modeling Practice and Theory.
- **Conferences:** ASME Dynamics Systems and Control Conference; ASME International Mechanical Engineering Congress & Exposition; American Control Conference; European Control Conference; IEEE Forum on Integrated and Sustainable Transportation System; IEEE Conference on Decision and Control; IEEE Vehicle Power and Propulsion Conference

Session Chair

- 2009 University of Michigan Graduate Symposium, Design & Control Systems Session
- 2008 University of Michigan Graduate Symposium, Control Systems Session

Web Design

- Student Services Site for the 2009 American Control Conference, St. Louis, MO
- 2008 and 2009 University of Michigan Graduate Symposium
- International Union of Theoretical and Applied Mechanics (IUTAM) Symposium on Cellular, Molecular and Tissue Mechanics, Woods Hole, MA

Appointments and Experience

University of California, San Diego (July 2011 – June 2012)
UC President's Postdoctoral Fellow

University of Michigan – Ann Arbor, Michigan (August 2006 – April 2011)
Graduate Student Research Assistant

DaimlerChrysler Corporation – Detroit, Michigan (May 2006 - August 2006)
Summer Intern, Electrical Engineering - Vehicle Engineering

Ford Motor Company - Dearborn, Michigan (May 2005 - August 2005)
Summer Intern, Manufacturing & Quality

Southern California Edison - Rosemead, California (June 2004 - August 2004)
Professional Aide, Staff Engineering

BIS Computer Solutions, Inc. - La Crescenta, California (June 2003 - July 2003)
Sales Assistant, Computer Technician

Instrumental Music Experience

Instruments

Oboe, English horn, Alto/Tenor/Baritone Sax, Timpani, Cymbals, Bass Drum, Conducting

Performance Groups

University of Michigan Pops Orchestra	(September 2010 – April 2011)
University of Michigan Campus Philharmonic Orchestra	(September 2009 – March 2010)
University of Michigan Campus Band	(January 2009 – April 2009)
UC Berkeley Symphony Orchestra	(2003 - 2006)
UC Berkeley University Wind Ensemble	(January 2003 – May 2006)
California Marching Band	(September 2003 – May 2006)
Mystikal Drum & Bugle Corps	(April 2004 – July 2004)