Donald J. Docimo

Postdoctoral Research Associate, Alleyne Research Group
Department of Mechanical Science and Engineering
University of Illinois at Urbana-Champaign **Email:** ddocimo@illinois.edu

RESEARCH FOCUS

Research interests focus on the application of modeling, estimation and control theory to energy systems, with applications including electro-thermal systems, battery packs, building energy, and photovoltaics.

EDUCATION

Ph.D. in Mechanical Engineering
The Pennsylvania State University, 12/2017, 3.98/4.0 GPA

- Dissertation title: Insights into the Behavior of Heterogeneous Thermostatically Controlled Loads and Battery Packs
- Dissertation advisor: Hosam K. Fathy

M.S. in Mechanical Engineering
The Pennsylvania State University, 12/2015, 3.98/4.0 GPA

B.S. in Mechanical Engineering
The College of New Jersey, 05/2012, 3.8/4.0 GPA

RESEARCH EXPERIENCE

Postdoctoral Research Associate, Alleyne Research Group
University of Illinois at Urbana-Champaign, 2017-Present

- Postdoc advisor: Andrew Alleyne
- Hierarchical control and graph-based modeling of electro-thermal energy systems
- Part of the NSF Engineering Research Center: Power Optimization of Electro-Thermal Systems

Graduate Research Assistant, Control Optimization Lab
The Pennsylvania State University, 2013-2017

Battery Control

- Development of LQR and MPC balancing algorithms to improve battery pack lifespan
- Battery model development, parameter identification and experimental validation

Building Energy Systems

- Modeling/characterization of aggregate AC power demand of heterogeneous buildings
- Models and results applicable for demand response control and renewable resource integration

HEV System Modeling/Control

- 1st place in the 2012-2013 EcoCAR competition to hybridize a vehicle
- Assisted team with modeling/control of motor/generator, brake system, and chassis

Independent Research on Control of Photovoltaic (PV) Systems
2014-Present

- Publications on novel temperature/irradiation estimators for PV systems using EKF techniques

- Development of novel control strategies for maximum power point tracking

Grant Proposal Team Member, PIRE: Simulation-Based Innovation and Life-Prolonging Control for Electrochemical Batteries
The Pennsylvania State University, 2016

- Assistant in preparation of a $5.25 million NSF PIRE proposal
- Part of the red team, which internally evaluates the proposal's quality

PUBLICATIONS

Journal Articles

[1] **D.J. Docimo** and H.K. Fathy, "Demand Response Using Heterogeneous Thermostatically Controlled Loads: Characterization of Aggregate Power Dynamics," *J. of Dynamic Systems, Measurement, and Control*, vol. 139, no. 10, pp. 101009, 2017.

[2] **D.J. Docimo**, M. Ghanaatpishe, and A. Mamun, "Extended Kalman Filtering to Estimate Temperature and Irradiation for Maximum Power Point Tracking of a Photovoltaic Module," *Energy*, vol. 120, pp. 47-57, 2017.

[3] **D.J. Docimo** and H.K. Fathy, "Multivariable State Feedback Control as a Foundation for Lithium-Ion Battery Pack Charge and Capacity Balancing," *J. of the Electrochemical Society*, vol. 164, no. 2, pp. A61-A70, 2017.

[4] M.J. Rothenberger, **D.J. Docimo**, M. Ghanaatpishe, and H.K. Fathy, "Genetic Optimization and Experimental Validation of a Test Cycle that Maximizes Parameter Identifiability for a Li-Ion Equivalent-Circuit Battery Model," *J. of Energy Storage*, vol. 4, pp. 156-166, 2015.

Magazine Articles

[1] **D.J. Docimo**, M. Ghanaatpishe, M.J. Rothenberger, C.D. Rahn, and H.K. Fathy, "The Lithium-Ion Battery Modeling Challenge: A Dynamic Systems and Control Perspective," *Dynamic Systems and Control Mag.*, vol. 136, no. 6, pp. 7-14, June, 2014.

Conference Papers

[1] **D.J. Docimo** and H.K. Fathy, "Characterization of Damping and Beating Effects Within the Aggregate Power Demand of Heterogeneous Thermostatically Controlled Loads," in *ASME 2015 Dynamic Systems and Control Conf.*, 2015.

[2] **D.J. Docimo**, M. Ghanaatpishe, and A. Mamun, "Feedback-Based Temperature and Irradiation Estimation for Photovoltaic Modules," in *ASME 2015 Dynamic Systems and Control Conf.*, 2015.

[3] **D. Docimo**, M. Ghanaatpishe, and H. K. Fathy, "Development and Experimental Parameterization of a Physics-Based Second-Order Lithium-Ion Battery Model," in *ASME 2014 Dynamic Systems and Control Conf.*, 2014.

TEACHING EXPERIENCE

Instructor, Powertrain System Modeling, Simulation and Control
The Pennsylvania State University, 2017

- Instructor for a senior level, specialty topics course
- Course on the modeling/control of vehicle powertrain components

Online Multimedia Course: Model-Based Design Series– Battery Systems
Control Optimization Lab, the Pennsylvania State University, 2013

- Developed an online multimedia course about modeling and safely controlling battery packs in hybrid-electric vehicles (HEVs)

- Topics include state observers, cell balancing, and degradation detection
- Available on MATLAB Courseware: http://www.mathworks.com/academia/courseware/

Experience with Undergraduate Student Advising
Control Optimization Lab, the Pennsylvania State University, 2016
- Helped advise student Carolyn Orth on battery modeling and parameter identification
- Guided experimental validation of frequency regulation using battery packs

Teaching Assistant
The Pennsylvania State University

Dynamic Systems Laboratory, 2016
- Instruction of lab experiments including industrial emulators and robotic arms
- Teaching of basic controls concepts including block diagrams and PID controllers

Thermodynamics, 2012
- Provided office hours, graded individual and group assignments, and proctored exams

HONORS AND AWARDS

Graduate Teaching Fellow, *The Pennsylvania State University, 2017*
Graduate student instructor of a mechanical engineering course.

Gabron Family Graduate Fellowship, *The Pennsylvania State University, 2013*
Fellowship awarded to select first year graduate students in mechanical engineering.

Penn State CERF Fellowship, *The Pennsylvania State University, 2012-2013*
Select fellowship for start of Ph.D. in engineering at Penn State.

1st place, EcoCAR competition, *The Pennsylvania State University, 2013*
Member of the team which placed first in the EcoCAR 2, year 2 competition.

TCNJ Merit Scholarship, *The College of New Jersey, 2008-2012*
Merit-based scholarship for undergraduate students.

Magna cum laude, *The College of New Jersey, 2012*

Dean's list (8 semesters), *The College of New Jersey, 2008-2012*

PROFESSIONAL EXPERIENCE

Mechanical Engineering Intern, Geospatial Systems
ITT Corporation, Summer 2010
- Researched materials for protection of ground-based equipment as well as satellites
- Designed and documented aerospace electronic packaging systems and testing equipment

Mechanical Engineering Intern, ES/EW Systems
ITT Corporation, Summer 2009
- Designed electronic packaging systems of aerospace vehicles, including thermal analysis
- Documented and organized components for packaging systems

PRESENTATIONS AND POSTER SESSIONS

- Presenter, Air Force Research Lab, "Using Control Theory to Extend Battery Pack Lifespan for Electric Vehicles," January 2017
- Guest class lecturer, Modeling of Dynamic Systems, February 2015

- Poster Session, Workshop on Power Systems & Markets, November 2015
- Presenter, Dynamic Systems and Control Conference, October 2015
- Presenter, Dynamic Systems and Control Conference, October 2014

LEADERSHIP AND SERVICE

- Session Co-Chair, Dynamic Systems and Control Conference, HVAC Building Energy Management (Invited Session), October 2015
- Team Captain, SAE Aero Design East Competition, the College of New Jersey, 2012
- Member, Varsity Cross Country and Track & Field, the College of New Jersey, 2008-2012
- Secretary, ASME Club, the College of New Jersey, 2010-2011

TECHNICAL SKILLS

- Modeling and model reduction: Padé approximation, finite differences, collocation methods
- Estimation: Luenberger observers, Extended/Unscented Kalman Filtering, particle filters
- Control of physical systems: inverted pendulum, robotic arm, magnetic levitation, gyroscope
- Proficient in MATLAB (including Simulink) and Visual C++
- Arbin battery cycler hardware and software
- Arduino programming and implementation in mechatronic systems