

Shumon Koga

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SUMMARY

- Researcher specializing in algorithms development of control systems and machine learning for robotics, battery management, additive manufacturing, and HVAC.
- Interdisciplinary engineer with experience working with hardware engineers and physicists
- Internship experience at NASA Jet Propulsion Laboratory and Mitsubishi Electric Research Laboratories

EDUCATION

Ph.D. in Mechanical and Aerospace Engineering	Sep. 2014-June 2020
University of California San Diego, La Jolla, CA	GPA: 3.86
M.S. in Mechanical and Aerospace Engineering	Sep. 2014-Mar. 2016
University of California San Diego, La Jolla, CA	GPA: 3.91
B.S. in Applied Physics	Apr. 2010-Mar. 2014
Keio University, Tokyo, Japan	GPA: 3.75

EXPERIENCE

University of California San Diego, Electrical and Computer Engineering, La Jolla, CA **Jul. 2020-**

Postdoctoral Scholar | Interests: Robotics, Machine learning, SLAM, Perception, Path planning

University of California San Diego, Mechanical Engineering, La Jolla, CA **Sep. 2014-June 2020**

Research Assistant | Interests: PDE Control, Extremum seeking, 3D-printing, Lithium-ion batteries

- Developed the nonlinear control algorithms and estimation algorithms for physics-based model of melting processes.
- Conducted extensive numerical validations using MALTAB/Simulink and Python to implement the algorithms with finite difference and finite element methods.
- Initiated and led collaborative work with physicists and hardware engineers to conduct experiments.
- Implemented the proposed estimation algorithm and Extended Kalman filter for state-of-charge estimation of lithium-ion batteries with safe and low cost materials via an electrochemical model.
- Tested and validated the designed feedback control in physical experiments of melting paraffin.
- Developed a novel data-driven optimization method with applications to traffic congestion control.
- Supervised four visiting students for their projects, all of which succeeded in completing their project on-time, with the expected deliveries, i.e., codes, prototypes and publications.

Mitsubishi Electric Research Laboratories (MERL), Cambridge, MA **June 2018-Sep. 2018**

Intern | Project “Learning-Based State Estimation for Thermal and Fluid Systems”

- Developed a learning-based state and parameter estimation algorithm for airflow dynamics in a room with an HVAC system using data-driven extremum seeking and LMI-based Luenberger state observer.

NASA Jet Propulsion Laboratory (JPL), Pasadena, CA **Oct. 2017-Nov. 2017**

Research Intern | Project “Estimating the Circulation and Climate of the Ocean (ECCO)”

- Derived a new state estimation algorithm of a global climate model using adjoint method and gradient-based optimization.

Keio University, Tokyo, Japan **Apr. 2013-Mar. 2014**

Undergraduate Student Researcher | Interests: Stochastic Optimal Control, Kalman Filter, Thermodynamics

- Developed an optimal control method for maximizing the power output of a stochastic heat engine by using nonlinear optimization, Extended Kalman Filter, and LQG control.
- Generated C programming codes to implement the designed control algorithm in numerical simulation.

AWARDS

2019: O. Hugo Schuck Best Paper Award, American Automatic Control Council

2018: Outstanding Graduate Student Award, UC San Diego, Mechanical and Aerospace Engineering

SKILLS

Programming: C, C++, MATLAB, Simulink, Python, Fortran, Mathematica

Controls: PID, bang-bang, extremum seeking, pole placement, LQR, LQG, H infinity, model predictive control (MPC), dynamic programming, motion planning, feedback linearization, sliding mode, energy-shaping

Estimation: Kalman filter, EKF, UKF, particle filter, Bayesian filter, recursive least square, adjoint method

Machine learning: SVM, neural network, deep learning, gradient descent, boosting, reinforcement learning

Digital signal processing: DFT, FFT, STFT, Periodogram, ARMA modeling, Levinson-Durbin, lattice filters

LEADERSHIP

Vice President, Japanese Graduate Student Association in US (JGSAU)

Mar. 2016-Feb. 2019

- Managed multi-site meetings for organizing lectures on presenting graduate programs in the US, which have been held at more than 10 universities in Japan every year since 2010, supported by US embassy.

SELECTED PUBLICATIONS

Number of journal papers: 14 in total (9 as a first author), 10 published (6 as a first author)

Number of conference papers: 14 in total and published (10 as a first author)

Controls/Learning

- **S. Koga**, M. Benosman, and J. Borggaard, “Learning-Based Robust Observer Design for Coupled Thermal and Fluid Systems”, 2019 American Control Conference, 2019
- **S. Koga**, M. Diagne, and M. Krstic, “Control and State Estimation of the One-Phase Stefan Problem via Backstepping Design”, IEEE Transactions on Automatic Control, 2019
- J. Feiling, **S. Koga**, M. Krstic, T. R. Oliveira, “Gradient Extremum Seeking for Static Maps with Actuation Dynamics Governed by Diffusion PDEs”, Automatica, 2018
- **S. Koga**, M. Makihata, R. Chen, M. Krstic, and A.P. Pisano, “Energy Storage in Paraffin: a PDE Backstepping Experiment”, IEEE Transactions on Control Systems Technology, under review

Battery Management

- **S. Koga**, L. Camacho-Solorio, and M. Krstic, “State Estimation for Lithium Ion Batteries with Phase Transition Materials”, ASME 2017 Dynamic Systems and Control Conference, 2017

Additive Manufacturing

- **S. Koga**, M. Krstic, and J. Beaman, “Laser Sintering Control for Metal Additive Manufacturing by PDE Backstepping”, IEEE Transactions on Control Systems Technology, accepted
- **S. Koga**, D. Straub, M. Diagne, and M. Krstic, “Stabilization of Filament Production Rate for Screw Extrusion-Based Polymer 3D-Printing”, ASME Journal of Dynamic Systems, 2019

Traffic

- H. Yu, **S. Koga**, and M. Krstic, “Stabilization of Traffic Flow with a Leading Autonomous Vehicle”, ASME 2018 Dynamic Systems and Control Conference, 2018