Shumon Koga, PhD

E-mail: skoga@ucsd.edu, Phone: +1-(858)-245-3541, Web: https://shumon0423.github.io

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.
- Successful internship experience at NASA Jet Propulsion Laboratory on data science in climate dynamics and Mitsubishi Electric Research Laboratories on learning of HVAC system.

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

- Developing an autonomous motion planning algorithm to reduce uncertainty in EKF-based mapping with depth-sensors (e.g., lidar, RGB-D camera) using reinforcement learning. Utilizing open source codes such as Open AI gym, and libraries including Pytorch and Tensorflow, with Python programming.
- Organizing ICRA 2021 workshop on robot safe control with learning through inviting speakers to strengthen connections among the communities of control theory, robotics, and machine learning.

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 nonlinear control and estimation algorithms for a 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 real-time feedback control in physical experiments of melting paraffin.
- 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 novel state and parameter estimation algorithm of a global climate model to minimize square

root errors from sensory data by satellites using the 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 programing codes to implement the designed control algorithm in numerical simulation.

AWARDS

2020: Robert E. Skelton Systems and Control Dissertation Award, UCSD Center for Control Systems and Dynamics (CCSD).

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, Baysian filter, recursive least square, adjoint method

SELECTED PUBLICATIONS

Number of journal papers: 15 (10 as a first author), Number of conference papers: 15 (13 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
- 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, 2021

Robotics

- **S. Koga**, A. Asgharivaskasi, and N. Atanasov, "Active Exploration and Mapping via Iterative Covariance Regulation over Continuous SE(3) Trajectories", IEEE/RSJ International Conference on Intelligent Robots and Systems, 2021, submitted.

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, 2020
- **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