EDWIN GOH

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EDUCATION

Georgia Institute of Technology, Atlanta, GA

Ph. D. in Aerospace Engineering (Advised by Dr. Jerry M. Seitzman) *2016 – 2020*
Dissertation: "Reduced-Order Model for Prediction of Staged-Combustor NOx
 Emissions with Detailed Chemistry and Finite-Rate Mixing" (link)
M.S. in Aerospace Engineering
B.S. in Aerospace Engineering *2012 – 2015*

RESEARCH FOCUS

My research focuses on the infusion of cutting-edge machine learning developments into the safety-conscious aerospace community. Advances in reinforcement learning (RL) as a generalized optimization approach under complex constraints and stochastic environments allow it to excel in multidisciplinary aerospace problems such as mission planning/scheduling [C5] and design of various air/spacecraft subsystems. However, RL typically relies on efficient simulation environments in which agents can be trained. Parallel developments in deep learning (DL) have significantly decreased the computational cost of intensive simulations such as combustion [J3][J4] and aerodynamics. My research aims to combine the efficiency of state-of-the-art physics-informed DL techniques with the human-like creative capabilities afforded by RL to develop novel frameworks that *learn strategies* rather than search a parameter space. This research has diverse applications in the areas of operations research, planetary/earth science, and energy.

EXPERIENCE

NASA Jet Propulsion Laboratory *Feb 2020 – Present*
Data Scientist
- Principal investigator on pilot project Contrastive Learning for Onboard Vision-Enabled Robotics (CLOVER)
- Led deep RL solution development to automate the scheduling of NASA's Deep Space Network (DSN)
- Researched automated and self-supervised ML systems on DARPA Data-Driven Discovery of Models program
- Developed neuromorphic computing use-case for onboard rover ML and presented to NASA collaborators
- Interfaced with JPL contributors and university partners to write research proposals leveraging AI/ML
- Submitted multiple DL-based proposals across multiple domains, amounting to $4M in cumulative funding

Ben T. Zinn Combustion Lab — Georgia Tech, Atlanta, GA *Jan 2016 – Jan 2020*
Graduate Research Assistant — DOE Optimized Low-NOx Staged Combustor Development
- Developed simulation suite in Python and MATLAB for preliminary combustor design and optimization
- Created an interactive data visualization interface for real-time analysis of terabytes of simulation data
- Elucidated key effects of non-ideal flow conditions on NOx formation and combustor design
- Researched deep learning models to accelerate simulations by "learning" compute-intensive sections

Undergraduate Research Assistant — FAA Alternate Jet Fuel Ignition Testing *Jan 2015 – Dec 2015*
- Performed preliminary design of forced ignition testing facility for liquid fuels
- Modified and optimized existing reduced-order simulation model to achieve 3x performance increase
- Determined ignition probability and performance for alternative jet fuels under various conditions

UPS — Atlanta, GA *May 2019 – Nov 2019*
Data Science Co-op
- Developed prototype customer profiler for price optimization using regression and clustering techniques
- Formulated MILP problems to optimize UPS' last-mile delivery network in EU
- Enabled 2X speedup of a shortest-path network optimization subroutine by scaling to 960 cores

TEACHING AND MENTORING EXPERIENCE

AE 6362 – Safety by Design and Flight Certification
Graduate Teaching Assistant *Jan 2019 – May 2019*

- Guided students in applying industrial safety assessment standards in UAM projects
- Received a 4.8/5.0 overall evaluation for the semester, with 4.9/5.0 on oral communication

Georgia Tech Center for Teaching and Learning (CETL)
Tech to Teaching Program
- Completed graduate-level coursework on teaching and learning in higher education, oriented at future faculty
- Completed mini-capstone lecture on fundamentals of aerodynamics to positive peer review and feedback

RELEVANT PROJECTS

Intelligent Inventory Management System
Boeing Innovation Challenge Project (Seattle, WA)   *January 2019*
- Proposed ML solution to curtail inventory in Boeing's balance sheet and reduce costs associated with delays
- Addressed lack of proprietary procurement history by simulating 50-year order data for Boeing 737
- Robust problem identification and solution methodology received positive feedback from Boeing executives

Lattice Boltzmann Method (LBM) CFD Simulation
High Performance Parallel Computing Course Project   *Fall 2017*
- Implemented LBM fluid dynamics solver using C and CUDA
- Verified solution against theoretical flow (Taylor-Green Vortex) with analytical solution
- Optimized GPU implementation achieved 10x increase in GPU memory bandwidth, resulting in 90% speed-up

PROFESSIONAL/SERVICE ACTIVITIES
- American Institute of Aeronautics and Astronautics (AIAA), senior member
- Reviewer for American Chemical Society (ACS) journal Energy & Fuels
- Reviewer for Elsevier journal Process Safety and Environmental Protection

JOURNAL PUBLICATIONS

[J1] Guillaume, A., **Goh, E.**, Johnston, M.D., Wilson, B.D., Ramanan, A., Tibble, F., Lackey, B. (2022). Deep Space Network Scheduling using Quantum Annealing. *IEEE Transactions on Quantum Engineering,* 3, 1-13

[J2] Claudet, T., Alimo, R., **Goh, E.**, Johnston, M.D., Madani, R., Wilson, B. (2022). Δ-MILP: Deep Space Network Scheduling via Mixed-Integer Linear Programming. *IEEE access,* 10, 41330-41340.

[J3] **Goh, E.**, Li, J., Kim, N.Y., Lieuwen, T. and Seitzman, J. (2021). Finite-rate entrainment effects on nitrogen oxide (NOx) emissions in staged combustors. *Combustion and Flame*, 230, 111-434.

[J4] **Goh, E.**, Sirignano, M., Li, J., Nair, V., Emerson, B., Lieuwen, T. and Seitzman, J. (2019). Prediction of minimum achievable NOx levels for fuel-staged combustors. *Combustion and Flame*, 200, 276-285.

CONFERENCE PUBLICATIONS

[C1] **Goh, E.**, Ward, I.R., Vincent, G.M., Pak, K., Chen, J. (2023). Self-Supervised Distillation for Computer Vision Onboard Planetary Robots. 2023 IEEE Aerospace Conference. IEEE (Accepted)

[C2] Ward, I.R., Moore, C., Pak, K., Chen, J., **Goh, E.** (2022). Improving Contrastive Learning on Visually Homogeneous Mars Rover Images. European Conference on Computer Vision (ECCV) Workshop on AI4Space.

[C3] Vincent, G.M., Yepremyan, A., Chen, J., **Goh, E.** (2022). Mixed-domain Training Improves Multi-Mission Terrain Segmentation. European Conference on Computer Vision (ECCV) Workshop on AI4Space.

[C4] **Goh, E.**, Chen, J., Wilson, B. (2022). Mars Terrain Segmentation with Less Labels. 2022 IEEE Aerospace Conference. IEEE.

[C5] **Goh, E.**, Venkataram, H.S., Hoffmann, M., Johnston, M. and Wilson, B. (2021). Scheduling the NASA Deep Space Network with Deep Reinforcement Learning. 2021 IEEE Aerospace Conference. IEEE.

[C6] Allison, T., Burke, W., Constantinou, V., **Goh, E.**, Mattmann, C., Mensikova, A., Southam, P., Stonebraker, R. and Timmaraju, V. (2020). Building a Wide Reach Corpus for Secure Parser Development. 2020 IEEE Security and Privacy Workshops (SPW) 318-326. IEEE.

[C7] **Goh, E.**, Sirignano, M., Nair, V., Emerson, B., Lieuwen, T. and Seitzman, J. (2017). Modeling of Minimum NOx in Staged-Combustion Architectures at Elevated Temperatures. In ASME Turbo Expo 2017: Turbomachinery Technical Conference and Exposition. American Society of Mechanical Engineers Digital Collection.