

# JOSTEIN BARRY-STRAUME

Machine Learning Engineer | U.S. Citizen

@ jostein@vt.edu

📍 Seattle, WA

📍 Blacksburg, VA

in [linkedin.com/in/josteinbarrystraume/](https://www.linkedin.com/in/josteinbarrystraume/)

📄 [github.com/josteinbarrystraume](https://github.com/josteinbarrystraume)

## EXPERIENCE

Rolls-Royce Graduate Fellow

**Rolls-Royce University Technology Center | Virginia Tech**

📅 Fall 2023 – Present

📍 Blacksburg, VA

- Investigate uncertainty quantification (UQ) methods for neural networks to predict turbine gas temperature (TGT), using engine health management (EHM) data, with quantifiable uncertainty
- Correlate TGT predictions with engine degradation to prediction remaining useful lifespan (RUL) of various turbofan engines
- Leverage civilian EHM datasets and infer on naval EHM datasets via transfer learning
- Benchmark and evaluate success between the following: Bayesian method, bootstrap method, delta method, mean-variance estimation, lower upper bound estimation
- Evaluation metrics include: Prediction interval (PI) coverage probability, normalized mean PI width, coverage width criterion
- Follow American Society of Mechanical Engineers (ASME) standards of Verification, Validation and Uncertainty Quantification (VUQ)
- Comply with National Institute of Standards and Technology's (NIST) standards of VUQ
- Research improving upon existing UQ methods via knowledge-guided machine learning and physics-informed neural networks (PINNs)
- Present results to non-technical Rolls-Royce and U.S. Navy stakeholders in a digestible manner

Graduate Research Assistant

**Computational Science Laboratory | Virginia Tech**

📅 Aug 2020 – Present

📍 Blacksburg, VA

- Apply physics-informed neural networks (PINNs) to optimal control problems
- Leverage automatic differentiation to impart the physical laws of a dynamical system into a neural network's training regiment (PyTorch and TensorFlow)
- Implement custom neural network loss functions that use mixed and partial derivatives via automatic differentiation (PyTorch and TensorFlow)
- Develop a novel one-stage open-loop control physics-informed neural network (CPINN) to simultaneously solve the learning tasks of a dynamical system and its respective optimal control
- Demonstrate success of open-loop CPINN via optimal control problems of increasing complexity: analytical ODE, one-dimensional heat equation, and two-dimensional predator-prey (Lotka-Volterra) problem formulated as a reaction-diffusion problem
- Develop an ensemble based closed-loop optimal control using PINNs to learn the optimal cost-to-go, and subsequently the respective optimal control signal, by solving the Hamilton-Jacobi-Bellman (HJB) equation
- Demonstrate success of ensemble-based closed-loop CPINN by solving a time-invariant two-state continuous nonlinear system with an infinite time horizon, accounting of noisy, perturbed system states and varying initial conditions
- Present results at Association for the Advancement of Artificial Intelligence (AAAI) Fall 2022 Symposium on Knowledge-Guided Machine Learning; 2024 Society for Industrial and Applied Mathematics (SIAM) Annual Meeting

## EDUCATION

Virginia Tech

**Ph.D. in Computer Science**

📅 Aug 2020 – Present

📍 Blacksburg, VA

- Major GPA: 3.95/4.0
- Advisor: Dr. Adrian Sandu (<https://cs1.cs.vt.edu/>)
- Co-Advisor: Dr. Changmin Son (<https://rollsroyce.me.vt.edu/>)

Southern Methodist University

**Master's in Data Science**

📅 May 2017 – Dec 2018

📍 Dallas, TX

- Major GPA: 4.0/4.0
- Machine Learning Specialization
- Department of Engineering
- Advisor: Dr. Daniel W. Engels
- Co-Advisor: Edward Fine

University of Southern California

**Bachelor's in Economics**

📅 Los Angeles, CA

## TECHNICAL SKILLS

Python

PyTorch

TensorFlow

Matlab

NumPy

Pandas

Scikit-learn

Keras

Anaconda Navigator

Jupyter Notebook

Git

GitHub

GitLab

R

SQL

LaTeX

## PRESENTATIONS

- "Physics-Informed Neural Networks for PDE-Constrained Optimization and Control." 2024 SIAM Annual Meeting. July 11, 2024. Spokane, WA, USA. [https://meetings.siam.org/session/dsp\\_programsess.cfm?SESSIONCODE=79952](https://meetings.siam.org/session/dsp_programsess.cfm?SESSIONCODE=79952)
- "Machine learning for predicting turbine gas temperature under uncertainty." Internal meeting with executive stakeholders at Rolls-Royce North America. December 14, 2023. Indianapolis, Indiana, USA. Significant contribution to securing funding for three different Virginia Tech labs.
- "Physics-informed neural networks for PDE-constrained optimization and control." Knowledge-guided Machine Learning. AAAI Fall Symposium Series (FSS) 2022. November 17-19, 2022. Arlington, Virginia, USA. <https://sites.google.com/vt.edu/kgml-aaai-22>.
- "An evaluation of training size impact on validation accuracy for optimized convolutional neural networks." Southern Methodist University. December 18, 2018. Dallas, Texas, USA. Master's capstone presentation. Winner of best presentation award.

# EXPERIENCE CONTINUED

## Givens Associate - Mathematics & Computer Science Argonne National Laboratory

📅 Summer 2022      📍 Lemont, IL

- The Givens Associate positions are intended to encourage professional growth in graduate students who are beginning careers in numerical analysis or computational mathematics
- Research the following automatic differentiation modes: reverse (back-propagation), forward, and mixed (mixing and matching both reverse and forward in the same neural network)
- Contribute to the development of AutoMAD, a mixed mode automatic differentiation API for PyTorch's automatic differentiation engine (Autograd): <https://github.com/jhueckelheim/AutoMAD>
- Develop alternative automatic differentiation formulations for machine learning frameworks
- Help develop new methods for gradient computations
- Apply new methods to a variety of neural networks

## Information Systems & Modeling - Ph.D. Intern

### Los Alamos National Laboratory

📅 Summer 2022      📍 Los Alamos, NM

- Research approaches in risk assessment and risk reduction for national critical cyber and physical infrastructure
- Apply natural language processing (NLP) techniques to decompose national critical functions (NCFs) into sub-functions for the purposes of highlighting vital functional resilience and potential vulnerabilities
- Contribute to graph analytics via network path analysis, critical node identification, and automated graph discovery (data analytics, machine learning, and NLP methods)
- Use NLP methods to highlight dependencies and cascading risk in NCFs as a functional graph
- Create a poster detailing accomplishments for the LANL Student Symposium
- Deliver project update presentations to group level management
- Summarize results of NLP work in a manuscript for publication

## Graduate Teaching Assistant

### Virginia Tech

📅 August 2020 - Present      📍 Blacksburg, VA

- CS3604: Professionalism in Computing:
  - Head Teaching Assistant (TA)
  - Lead class for the professor on an as need basis
  - Responsible for delegating grading to all TAs
  - Track overall grading weekly for over 300 students
  - Meet with students to approve and discuss project proposals, presentations, and reports
- CS3114/CS5040: Data Structures and Algorithm Analysis:
  - Course taught in Java
  - Debug homework/projects for students, explaining how and why their code isn't working properly to impart knowledge rather than simply telling them the answer
  - Grade coding assignments for space and time efficiency, object-oriented design principles, and well documented code commentary

## Data Science Intern

### Fortive

📅 Jun 2018 - Dec 2018      📍 Everett, WA

- Improve annual direct and indirect spend visibility with natural language processing (NLP) solutions
- Label unstructured procurement data with NLP methods to increase spend visibility by \$658 million
- Use regression neural network to forecast daily spend by supplier per operating company (mean absolute error: 11%)

## Data Analyst

### Microsoft

📅 May 2016 - May 2017      📍 Redmond, WA

- Support Worldwide Licensing sales teams with customized agreement quotes, price sheets and amendments for contract negotiations
- Identify and resolve discrepancies between Customer/Channel Price Sheets
- Maintain team error rate below 3% target

# PUBLICATIONS

- Jostein Barry-Straume, Jin-Sol Jung, Changmin Son, and Adrian Sandu. Machine learning for predicting turbine gas temperature under uncertainty. In preparation for ASME's Journal of Turbomachinery.
- Jostein Barry-Straume, Adwait D. Verulkar, Andrey A. Popov, Arash Sarshar, Adrian Sandu. Ensemble-based closed-loop optimal control using physics-informed neural networks. In preparation for Begell House's Journal of Machine Learning for Modeling and Computing.
- Jostein Barry-Straume, Arash Sarshar, Andrey A. Popov, and Adrian Sandu. Physics-informed neural networks for PDE-constrained optimization and control. arXiv:2205.03377 (2022). <https://arxiv.org/abs/2205.03377>. 19 citations as of 12/15/2024. Under review for publication in Springer's journal of Communications on Applied Mathematics and Computation.
- Jostein Barry-Straume, Adam Tschannen, Daniel W. Engels, and Edward Fine. An evaluation of training size impact on validation accuracy for optimized convolutional neural networks. SMU Data Science Review: Vol. 1: No. 4, Article 12 (2018). <https://scholar.smu.edu/datasciencereview/vol1/iss4/12/>. 35 citations as of 12/15/2024.