Apoorv Srivastava

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Research Interests: Applied Maths, Inverse Problems, Machine Learning, Optimization, UQ

EDUCATION

Stanford University   *Sep 2021 - Present*
Ph.D. Candidate, Mechanical Engineering (minor in Computational Math)   *GPA 4.02/4.00*
Improving estimation algorithms for inverse problems using Machine Learning and Optimization.

Stanford University   *Sep 2021 - Jun 2023*
Masters in Mechanical Engineering   *GPA 4.00/4.00*
Specialization in Automatic & Learning-based Controls and Optimization

Indian Institute of Technology Bombay (IIT Bombay)   *Jul 2016 - May 2020*
Bachelor of Technology (with Honours) in Civil Engineering   *GPA 9.51/10*
Ranked first in the department, Undergraduate Research Award, and FFE Scholarship

SELECTED PROJECTS

Improving Particle Filters using Deep Probabilistic models   *Jan 2024 - Present*
 – Using Deep Probabilistic models to improve importance sampling in Particle Filters, enhancing efficiency and accuracy of state estimation in high-dimension systems with fewer particles.

System Identification under Binary Observations *(In Preparation)*   *Oct 2023 - Present*
 – Developed metrics to quantify identifiability in dynamic systems with binary observations and designed optimization methods for improving system identifiability and uncertainty quantification.

Hyporheic zone modeling using Experimental Data   *Jul 2024 - Present*
 – Applied regression techniques, such as Gaussian processes, to model flow in the Hyporheic zone using experimental data, improving understanding of reaction constants and subsurface dynamics.

Denoising Diffusion for Learned Optimizers (Report, Git)   *Oct 2023 - Dec 2023*
 – Applied conditional Denoising Diffusion models to study ill-posed inverse problems. Developed a transformers-based system architecture to improve 3D human pose estimation from 2D keypoints.

Optimal Control for Grid Balancing (Report, Git)   *Mar 2023 - Jun 2023*
 – Designed Model Predictive Control strategies for residential energy storage systems enhancing grid stability, addressing challenges of renewable energy intermittency and demand fluctuations.

TECHNICAL SKILLS AND COURSEWORK

Mathematics & Computer Science	Optimization, Statistics Theory, Linear Algebra, Fourier Transform, Stochastic Differential Equations, Finite Element Method, PDEs, Machine Learning, Deep Generative Models, Parallel Programming, Optimal & Learning-based Control, Robot Autonomy, Control Design
Programming	Python, MATLAB, C++
Frameworks & Tools	Git, MPI, OpenMP, CUDA, PyTorch, Numpy, Scipy, Scikit-Learn, Keras, Pandas, Matplotlib, Plotly, LaTeX

WORK EXPERIENCE

Los Alamos National Lab - *Graduate Student Researcher*   *Jul 2023 - Sep 2023*
 – Investigated the failure of Bayesian filtering for estimation in stiff ODE systems and implemented adjoint model-based optimization techniques for efficient and accurate parameter estimation.

IMAC, EPFL - *Undegraduate Student Researcher* (Paper 1, Paper 2)   *May 2019 - Jul 2019*
 – Designed and implemented iterative optimization schemes for real-time control of non-linear system, validated against analytical solutions using the Karush-Kuhn-Tucker (KKT) optimality criterion.

Selected Publication

1. <u>A Srivastava</u>, DM Tartakovskty, "**Computable Kinetic Defect Measure for Hyperbolic Scalar Conservation Laws**", Submitted to Mathematics and Computers in Simulation.

2. <u>A Srivastava</u>, W Kang, DM Tartakovskty, "**Feature-Informed Data Assimilation**", Journal of Computational Physics, 2023. (Paper)

3. RB Muhammad, <u>A Srivastava</u>, et al., "**High-Precision Geosteering via Reinforcement Learning and Particle Filters**", Submitted to Computational Geosciences. (Paper)

4. AP Reksowardojo, G Senatore, <u>A Srivastava</u>, et al., "**Design and control of a prototype structure that adapts to loading through large shape changes**", IFAC, 2020. (Paper)

5. RB Muhammad, Y Cheraghi, S Alyaev, <u>A Srivastava</u>, RB Bratvold, "**Enhancing Geosteering With AI: Integrating a Decision-Making Robot Into a Cloud-Based Environment and Benchmarking Against Human Experts**", SPE Norway Subsurface Conf., 2024. (Paper)

The complete list can be found on my Google Scholar page: 🎓 Google Scholar

Additional Projects

Metabolite Dynamics in the Brain   *Jan 2023 - Present*
– Developed <u>Finite Element models</u> for Convection-Diffusion-Reaction process of brain metabolites in cortex for <u>parameter estimation</u> and uncertainty quantification using <u>in-situ experimental data</u>.

Kinetic Defect for Hyperbolic Conservation Laws (Submitted)   *Jan 2023 - Aug 2023*
– Developed algorithm to analytically identify unknown Kinetic Entropy Defect (KED) measure in kinetic formulation of <u>hyperbolic conservation laws</u> using the properties of the KED measure.

Feature-Informed Data Assimilation (FIDA) (Paper)   *Apr 2022 - Jan 2023*
– Developed a mathematical framework for <u>state estimation</u> using <u>set-valued observations</u> like level curves, demonstrating effectiveness with <u>Particle Filters</u> and custom likelihood functions.

State Estimation for High-Precision Geosteering (Paper 1, Paper 2)   *Nov 2022 - Oct 2023*
– Developed integrated <u>reinforcement learning (RL)</u> and <u>particle filter (PF)</u> framework for geosteering decision optimization. Demonstrated superior performance over traditional RL or PF methods.

List of earlier projects
– Mechanical Metamaterials and Deployable Structures   *Aug 2018 - May 2020*
– Structural Optimization using <u>Genetic Algorithm</u>   *July 2017 - Aug 2018*
– Stress Analysis using <u>Finite Element Method</u>   *Jan 2019 - May 2019*
– <u>Gaussian Processes</u> for data-driven material modeling   *Sep 2021 - Dec 2021*

The complete list and description can be found on my research page: 🧩 apoorv-s.github.io./research

Scholastic Achievements

– Awarded the Mechanical Engineering Department Fellowship.   *Stanford University, 2021*
– Received the Institute Silver Medal for academic excellence.   *IIT Bombay, 2020*
– Recipient of the Swiss National Science Foundation (SNSF) Scholarship.   *EPFL, 2019*
– Awarded the SC Mehrotra Prize for highest GPA in the class.   *IIT Bombay, 2018*

Extracurricular Involvements

– Mentor for the ME PhD mentorship program at Stanford University.   *Stanford University, 2022*
– Mentor for department academic mentorship program at IIT Bombay.   *IIT Bombay, 2018 - 2020*
– Served as subsystems head and design engineer for Team Shunya.   *IIT Bombay, 2017 - 2020*