Sudhi Sharma

Computational Model Developer

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Profile

An experienced engineering-researcher in applied mathematics with expertise in deep learning, Bayesian inference, uncertainty quantification and high performance computing for large scale data driven problems. Strong programming skills in Python, C++, TensorFlow and PyTorch for developing scalable algorithms and predictive models. Excellent capability to collaborate with cross-functional team members and communicating ideas with multiple stakeholders in the hierarchy. Equity, diversity, accessibility and inclusion champion (awarded by Digital Research Alliance of Canada) committed to fostering and upholding these values.

Areas of Expertise

- ❍ Supervised Machine Learning
- ❍ Bayesian Inference
- ❍ Uncertainty/Risk Aware Modelling
- ❍ Object Oriented Programming
- ❍ PyTorch, Tensorflow, MLOps
- ❍ Statistical tools - SPSS, SAS, R
- ❍ FEniCS, FreeFEM, Paraview
- ❍ Deep Neural Networks
- ❍ Time Series Forecasting
- ❍ Inverse Problems
- ❍ Python, C++, Fortran
- ❍ Infectious Disease modelling
- ❍ Linux, Shell Scripting, SLURM
- ❍ Ansys, Abaqus
- ❍ High-Performance Computing
- ❍ Filtering Algorithms
- ❍ Data Visualization using Matplotlib, Seaborn, Paraview
- ❍ Segmentation and Classification
- ❍ Numpy, Conda, Docker
- ❍ Markov Chain Monte Carlo

Professional Experience

Post-Doctoral Research Fellow, *Carleton University* **Ottawa, Canada** *10/2023 - present*

- **Bayesian Inference and Predictive Modelling for Infectious Diseases**
  - Led end-to-end development of uncertainty-aware predictive models, leveraging statistical analysis, machine learning, and time series forecasting to provide actionable insights utilizing open-source infection data from the Ministry of Health, Ontario and cellphone mobility data.
  - Developed and optimized state of the art Bayesian framework for the inverse problem of training high-dimensional, nonlinear compartmental models, leveraging parallel Markov Chain Monte Carlo (MCMC) algorithms on high-performance computing clusters.
  - Helped in securing $500,000 in funding for uncertainty-aware forecasting, demonstrating the value of data-driven insights in public health decision-making.
- **Uncertainty Quantification & Scalable Solver Development in HPC for Earthquake Wave Propagations**
  - Performed geospatial data analysis using QGIS and Python (Geopandas) to extract spatial patterns, identify correlations, created dynamic geospatial visualizations and animations using Matplotlib, Paraview etc. to provide predictive insights.
  - Developed mathematical algorithms for solving uncertianty aware 3D elastic wave propagation simulations for subsurface soil layers with varying impedance in high-performance clusters.
  - Integrated statistical and machine learning approaches such as nonlinear filtering to enhance geospatial forecasting models.

Research Associate (part time) *PMAK Precision Biomarkers Inc.* **London Ontario, Canada** *11/2023 - present*

- **Computer Vision for Medical Imaging**
  - Developed and optimized deep learning pipelines (convolutional neural networks with and without transfer learning) for automated segmentation of brain regions from MRI scans to aid in early Parkinson's diagnosis.
  - Built an automated data preprocessing pipeline for neuroimaging analysis, reducing data processing time by 20% and improving model efficiency.
  - Led hands-on data science and machine learning workshops, upskilling team members in TorchIO, Nilearn, and image processing techniques.
  - Managed end-to-end data analysis workflows, including statistical reporting, stakeholder communication, and result interpretation, ensuring research findings translated into actionable insights.

Associate Software Engineer, *Bentley Systems* **Kolkata, India** *02/2016 - 08/2017*

- **Software Engineering & CI/CD**
  - Collaborated with cross-functional teams, including developers, QA testers, and product managers, to enhance feature development and debugging efficiency.
  - Optimized and refactored object-oriented codebases to improve performance and maintainability.
  - Led the implementation of CI/CD pipelines for a large-scale C++ software product, streamlining development and deployment processes.

Education

Ph.D. *Structural Engineering* **Carleton University** *2017-2023*
CGPA: 11.4/12
Applied Probabilistic Machine Learning, Data Assimilation and Estimation in Dynamic State Space Models
M.Tech. *Structural Engineering* **Indian Institute of Technology, Guwahati** *2013-2015*
CGPA: 9.26/10
Random vibrations, Earthquake engineering, Dynamics of structures, Finite element analysis
B.Tech. *Civil Engineering* **Govt.College of Engineering, Kannur** *2008-2012*
CGPA: 8/10
Engineering mechanics, Structural analysis, Engineering mathematics-I, II, Structural design

Awards and Honours

- **Equity, Diversity, Inclusion & Accessibility (EDIA) Champion** – Digital Research Alliance of Canada, 2024, $\$30000$
- **Jagmohan Humar Graduate Student Fellowship** - Carleton University, 2022, $\$500$
- **International Doctoral Excellence Award** - Carleton University, 2020, Tuition waiver of $\$4000$/semester
- **Ontario Trillium Scholarship** - Ontario, 2017, $\$200000$ for 5 years

Online Courses & Certifications

- DeepLearning.AI Tensoflow Professional Developer: Coursera, October, 2024.
- Machine Learning and Deep Learning: Compute Canada Ontario Summer School (Virtual), June 13-17, 2023.
- CRM Summer School: Solving large systems efficiently in multiphysics numerical simulations, University of Laval, May 25-31,2021.
- FreeFEM days, 12th Edition, Virtual Workshop on FreeFEM++, December 10-11,2020.
- Ontario HPC Summer School, Centre for Advanced Computing, University of Ottawa, July 20-26,2019.

Grant Proposals

- Co-applicant: *Weston Family Foundation, Rapid Response 2024 program*
- Collaborator: *Canadian Institute of Health Research (CIHR), Project grant program 2024*
- Member: *NFRF Special Call 2022, Research for Post-pandemic Recovery*

Publications

1. **Sudhi Sharma**, Victorita Dolean, Pierre Jolivet, Brandon Robinson, Jodi D. Edwards, Tetyana Kendzerska and Abhijit Sarkar, *Scalable Solvers for Compartmental Models of COVID-19*, Mathematical Biosciences and Engineering, AIMS Press, 2023, 20(8): 14634- 14674. doi: 10.3934/mbe.2023655
2. **Sudhi Sharma**, Victorita Dolean, Pierre Jolivet and Abhijit Sarkar, *Multilevel Scalable Solvers for Stochastic Linear and Nonlinear Problems*, Journal of Computational Physics (submitted) (available in arXiv)
3. **Sudhi Sharma**, *Scalable Domain Decomposition Methods for Nonlinear and Time-Dependent Stochastic Systems* (Doctoral dissertation, Carleton University). Dissertation
4. **Sudhi Sharma**. *Geospatial COVID-19 Spread with Random Diffusion Coefficients*, OSF, 10 Feb. 2025, doi: 10.17605/OSF.IO/P3TH7 (Not peer reviewed).
5. A. K. Rathi, **Sudhi Sharma** and A. Chakraborty., *ICCM2016: Sequential Stochastic Response Surface Method using Moving Least Squares based Sparse Grid Scheme for Efficient Reliability Analysis*, International Journal of Computational Methods,World Scientific Publishing Company, 2019 Aug 13;16(05):1840017.

Conferences

1. **Sudhi Sharma**, Ajay Kumar Verma, Pierre Jolivet, Victorita Dolean Maini, and Abhijit Sarkar., *An Efficient Bayesian Computational Method using Scalable Solvers for Stochastic PDEs*, 16^{th} World Congress on Computational Mechanics and 4^{th} Pan American Congress on Computational Mechanics, Vancouver, British Columbia, Canada, July 21-26, 2024.
2. **Sudhi Sharma**, Brandon Robinson, Victorita Dolean, Pierre Jolivet, Rimple Sandhu, Mohammed Khalil, Jodi D. Edwards, Tetyana Kendzerska, Abhijit Sarkar, *Bayesian Inference of Geospatial COVID-19 Spread using Scalable Solvers*, The VI International Interdisciplinary Conference Waterloo, Canada, August 14-18, 2023.
3. **Sudhi Sharma**, Pierre Jolivet, Victorita Dolean, Abhijit Sarkar, *Domain Decomposition-based Scalable Solvers for Time Dependent and Nonlinear Stochastic Systems*, The VI International Interdisciplinary Conference Waterloo, Canada, August 14-18, 2023.
4. **Sudhi Sharma**, Brandon Robinson, Victorita Dolean, Pierre Jolivet, Jodi D. Edwards, Tetyana Kendzerska, Rimple Sandhu, Mohammed Khalil, Chris Pettit, Abhijit Sarkar., *Multilevel scalable solvers for sparse Bayesian learning of geospatial spread of COVID-19*, 27^{th} International Conference on Domain Decomposition Methods, Prague, July 25-29, 2022.
5. **Sudhi Sharma**, Victorita Dolean, Mohammed Khalil, Chris Pettit, Dominique Poirel, Abhijit Sarkar., *Scalable uncertainty quantification framework for spatio-temporal spread of COVID-19*, SIAM-UQ, April 12-15, 2022.