Shuvayan BRAHMACHARY
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github | linkedin

SUMMARY

"Result-driven Data Scientist with over 11+ years of expertise from **India, Japan** and **Germany** in scientific computing, specializing in differentiable physics-assisted neural networks, data-driven modeling, computational fluid dynamics, reduced order modelling and optimization. Expertise in developing novel solutions across aerothermal, oil & gas, mining industries. Proficient in spatio-temporal, time series forecasting, inverse modelling, aerodynamic shape optimization, fluid structure interaction. Successfully led a team of research interns on collaborative projects. I have also been part of significant partnerships with team from **JAXA, KAIST, Nvidia**, and **ISRO** on high-impact research initiatives. Published over **15** Journals (**3 selected as featured**), **16** international and national conference. "

EDUCATION

INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI, IITG *2013-2019*

PH.D IN FLUIDS AND THERMAL ENGINEERING, MECHANICAL ENGINEERING

- Finite Volume/Immersed Boundary Methods for Compressible Flows: Development and Applications

GAUHATI UNIVERSITY, GIMT *2008-2012*

B.E IN MECHANICAL ENGINEERING

- 2^{nd} position in the merit list of the Gauhati university

CORE SKILLS

PROGRAMMING LANGUAGES	***Experienced:*** Python | C | Matlab ***Familiar:*** Visual Basics
ML LIBRARIES	***Experienced:*** Pytorch | Phiflow ***Familiar:*** Nvidia Modulus | Deep XDE | Tensorflow
DL STACK	Diff. Phys. | ANN | CNN | Fourior Neural Operators | DeepOnet | PiNN
NLP STACK	Chat GPT 3.5 turbo 16k | Llama-3.1-70B
UNSUPERVISED ML	K-Means | Hierarchical clustering | DBSCAN | Random Forest
SUPERVISED ML	Linear Regression | Multi-variable Linear Regressions | Logistic Regression | PCA
PYTHON FLATFORM/STACK	Jupyter | Matplotplib | Numpy | Pandas | Scikit-learn | Seaborn
MODELLING	Finite volume | Finite difference
OPERATING PLATFORM	Linux | OSX | Windows
COMMERCIAL SIMULATION TOOLS	FoamExtend | ANSYS Fluent | ANSYS CFX | ANSYS Static structural
MESH GENERATION/TYPE SETTING TOOLS	ICEM CFD | Gambit | LaTeX
OPEN SOURCE OPTIMISATION TOOLS	NSGA @ KANGAL | SAEA @ MDOLAB
POST PROCESSING TOOLS	Tecplot | Gnuplot | Paraview | Inkspace
LANGUAGES	***Native:*** Bengali ***Fluent:*** English, Hindi, Assamese ***Beginner:*** French, German

EXPERIENCE

SCIML RESEARCHER, SHELL PLC *Sept. 2023 - Present / India*

- Spatio temporal prediction of full wave inversion (FWI) process to map earth's subsurface properties using Fourier Neural Operators (FNO). Potential deployment could result in a RNPV of **$50 million USD**
- Hierarchical Physics informed neural network as fast proxy for steady state prediction of temperature profile inside MCHE, potentially impacting upto **$5 million/LNG train**
- DeepONet-based neural operator for time series forecast of auto cool down sequence of an MCHE for fault detection. Successful fault detection could impact upto **$19.5 million/LNG train**
- LLM based agentic AI framework (LEO) for optimisation of complex single and multi-objective optimisation problems.
- Language model based evolutionary optimisation (LEO) is presently under review for publication in Neurocomputing Journal. (link)
- Hierarchical clustering for sementically similar images in hardhat datset based on ResNet 50 encodings.

Research Scientist, Technical University of Munich *Jan. 2022 - Sept. 2023 / Germany*

• Developed a Differentiable physics assisted neural network (DPNN) framework for accurate and fast spatio-temporal prediction of velocity flowfields for incompressible flow past random configurations. Benchmark DPNN against supervised learning using multiple architecture e.g., Unet, CNN, ResNet, ResNext, DenseNet, Dil-ResNet (link)

• Delivered 5 lectures (IN2298) on Introduction to advanced deep learning for physical simulations, optimisaiton and convergence, physical losses, differentiable physics and applications, improved updates at TUM. (link)

• Co-organised seminar and mentored students for the master course: Deep learning in Physics. (link)

Research Scientist, Kyushu University *Sept. 2019 - Sept. 2021 / Japan*

• Developed surrogate assisted evolutionary algorithm (SAEA)-based optimisation framework for aerodynamic shape optimisation of highspeed vehicles. This allows expensive CFD computations to be effectively replaced by accurate ML-based surrogates (link)

• Developed reduced order model assisted neural network for steady state prediction of flowfield inside scramjet intake. The framework was seen to be especially accurate for aerodynamic shape optimisation (link)

• Collaborated with scientist from JAXA for optimal scramjet combustor design using SAEA. (link)

• Collaborated with Researchers from KAIST for optimisation of multi-target rendezvous problems by using GPU super-parallelisation (link)

• Led a team of research interns (Mr. Ananthakrishnan Bhagyarajan and Mr. Aravind Karthik M) at Kyushu University with successful publiction in Journal (link)

PhD Scholar, IITG *Jan. 2013 - June. 2019 / India*

• Developed an inhouse immersed boundary based finite volume (IB-FV) solver for high-speed compressible flows. The overarching aim of the thesis was to develop, validate and apply the IB-FV solver for aerodynamic shape optimisation in collaboration with ISRO. (link)

• Collaborated to co-develop an novel cell centered gradient reconstruction approach named modified Green Gauss (MGG) (link)

• Collaborated to University of Rennes to optimise an nozzle configuration for minimum radial velocity which was later experimentally examined. (link)

Subject Matter Expert, Nanobiz Pvt. Ltd. *Jan. 2019-Apr. 2019 / India*

• Led a team while working as a subject matter expert to deliver the project titled "Technology landscape on artificial intelligence in the field of computational fluid dynamics" for Diamler, India

Assistant Project Engineer *Sept. 2012- Dec. 2012 / India*

• Worked as an asisstant project engineer for 3D design of a shock tube for its inhouse fabrication and setup at IITG

Training and Certifications

- Generative AI with Large Language Models by deeplearning.ai (website)
- Data Driven Engineering (DDE), Issac Newton Institute for Mathematical Science, Workshops 2023 (website)
- Institute for Computational and Mathematical Engineering (ICME), Stanford University, Summer Workshops 2021 | Fundamentals of Data Science: Machine learning, Deep learning, High Performance Computing (website)
- Large Language Model Agents by UC Berkley (ongoing) (website)
- R & D valuation (ongoing) and basic economics for technology by Shell, Plc
- GPU programming and applications with hands on training on NVIDIA's CUDA environment at IITG, 2014

Selected Publications

- Brahmachary, S., Thuerey, N.,*"Unsteady Cylinder Wakes from Arbitrary Bodies with Differentiable Physics-Assisted Neural Network"* (**Physical Review E**, 2024) Link
- Brahmachary, S., Bhagyarajan, A., and Ogawa, H.,*"Fast Estimation of Internal Flowfields in Scramjet Intakes via Reduced-Order Modeling and Machine Learning"* (**Physics of Fluids**, 2021, Selected as featured article) Link
- Brahmachary, S., Joshi, S., Panda, A., Konerapalli, K., Sagotra, A., Patel, H., Sharma, A., Jagtap, A., Kalyanaraman, K."Large Language Model-Based Evolutionary Optimizer: Reasoning with Elitism" Link

Others

- Invites talks at Karlsruhe institute of technology, Germany and Space Transportation Systems Engineering Laboratory, Kyushu University, Japan
- Blogs on topics "When Kolmogorov-Arnold network meet PiNNs: Good, Bad and the Ugly Link", "Differentiable Physics for Unsteady Fluid Dynamics Link", and "Principal component analysis in aerodynamic shape optimisation Link"
- Life member of the Society for Shock Wave Research (SSWR) and Member of the Soft Computing Research Society (SCRS)