



Shuvayan BRAHMACHARY  
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## SUMMARY

"Result-driven Data Scientist with over 5+ years of post-PhD expertise from **India, Japan** and **Germany** in scientific computing, specializing in differentiable physics-assisted neural networks, data-driven modeling, computational fluid dynamics, reduced order modeling 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 papers on themes related to ML, CFD and optimization".

## 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<sup>nd</sup> position in the merit list of the Gauhati University

## CORE SKILLS

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|------------------------------------|--|
| PROGRAMMING LANGUAGES              | <b>Experienced:</b> Python   C   Matlab <b>Familiar:</b> Visual Basic                          |
| ML LIBRARIES                       | <b>Experienced:</b> Pytorch   PhiFlow <b>Familiar:</b> Nvidia Modulus   Deep XDE   Tensorflow  |
| DL STACK                           | Diff. Phys.   ANN   CNN   Fourier 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 PLATFORM/STACK              | Jupyter   Matplotlib   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                          | <b>Native:</b> Bengali <b>Fluent:</b> English, Hindi, Assamese <b>Beginner:</b> French, German |

## EXPERIENCE

### SCIIML 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 semantically similar images in hardhat dataset 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, optimisation 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 publication 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 assistant project engineer for 3D design of a shock tube for its inhouse fabrication and setup at IITG

## TRAINING AND CERTIFICATIONS

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- Machine Learning in Production by deeplearning.ai ([website](#))
- 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

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- 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

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- Invites talks at Karlsruhe Institute of technology (KIT, Germany) and Space Transportation Systems Engineering Laboratory, Kyushu University (STSEL, 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)