



Rahul Halder, PhD

Post-Doctoral Researcher
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Research Interests

Model Order Reduction and Scientific Machine Learning, Multiphase Flow, Fluid-Structure Interaction, High Speed Flow, Renewable Energy, Hemodynamics, Computational Mechanics

Work Experience

- 2022 - Present Post-Doc Researcher, Mathematics Department, International School for Advanced Studies, Italy
- 2021 - 2022 Post-Doc Researcher, Aerospace Engineering Department, University of Michigan, Ann Arbor, USA
- 2020 - 2021 Research Scientist, Temasek Laboratory, Singapore

Education

- 2015 - 2020 PhD, Department of Mechanical Engineering, National University of Singapore, Singapore.
- 2013 - 2015 Master of Technology, Department of Mechanical Engineering, Thermal Engineering, Indian Institute of Technology, Madras, Chennai, India. CPI - 9.35/10.
- 2009 - 2013 Bachelor of Engineering, Department of Mechanical Engineering, Jadavpur University, Kolkata, West Bengal, India. CPI - 8.37/10.

Research Topics

Postdoctoral Research (September 2022- Present): "Reduced Order Model and Scientific Machine Learning in SISSA, Italy with **Prof. Gianluigi Rozza**"

***Industry 4.0** *Development of Physics-based and Data-Driven ROM for **Industrial Applications**. *Discretized Governing Equation-Based Physics-Informed Neural Network. *Galerkin Projection-based Reduced Order Model for **Annealing Furnace**. ***Cerebral Hemodynamics**.

Postdoctoral Research (August 2021- August 2022): "Linearized Reduced Order Model for High Aspect Ratio Wing in University of Michigan, USA with **Prof. Carlos Cesnik**"

*Development of ML-based Linearised strain-based nonlinear structural model. * **High Aspect Ratio Wing Aeroelasticity**. *Development of UM/NAST solver at the University of Michigan.

Research Scientist (April 2020- August 2021): "Reduced Order Model for Wave-Structure Interaction", PI of Project: **Prof. Khoo Boo Cheong**

*Smooth Particle Hydrodynamics for **Wave-Structure Interaction**. *Physics Informed Neural Network.

PhD Thesis (July 2015-March 2021): "Discrete Empirical Interpolation Method Augmented Non-Intrusive Reduced Order Model for Aeroelastic Instabilities and Gust Load Analysis" under **Prof. Khoo Boo Cheong**

*Development of linear and non-linear Non-Intrusive Reduced Order Model for the **aeroelastic instabilities and Gust-Load Analysis** *Aeroelastic instabilities under Periodic Gust Loads at Viscous Transonic Regime *Opensource Finite Volume Compressible flow solver SU2.

Masters Thesis (July 2014-July 2015): "Droplet generation in a microchannel with a controllable deformable wall " under **Prof. Ashish Kumar Sen**

*Flexible Micro-channel *Fluid-Structure Interaction ***Biomedical Application**

Journal Publications

1. Raj A., **Halder R.**, Parayil S., Sen A. K., "*Droplet generation in a microchannel with a controllable deformable wall*". *Microfluidics and Nanofluidics*, 20(7), pp.20:102, June 2016. <https://link.springer.com/article/10.1007/s10404-016-1768-4>
2. **Halder R.**, Damodaran M. and Khoo B.C., "*A Signal Interpolation Approach Augmented Linear Non-Intrusive Reduced Order Model for Aeroelastic Applications*". *AIAA Journal*, 58(1), pp.426-444, Jan 2020. <https://arc.aiaa.org/doi/abs/10.2514/1.J058529>
3. **Halder R.**, Damodaran M. and Khoo B.C., "*A Deep-Learning Based Nonlinear Reduced Order Model for Airfoil Gust and Aileron Buzz Response*". *AIAA Journal* 58(10), pp. 4301-4321, October 2020. <https://arc.aiaa.org/doi/abs/10.2514/1.J059027>
4. **Halder R.**, Damodaran M. and Khoo B.C., "*Computational Assessment of Transonic Airfoil-Gust Aeroelastic Response*". *AIAA Journal* 60(4), pp. 2597-2614, January 2022. <https://arc.aiaa.org/doi/abs/10.2514/1.J060344>
5. **Halder R.**, Damodaran M. and Khoo B.C., "*Deep learning-driven nonlinear reduced-order models for predicting wave-structure interaction*". *Ocean Engineering*, 280:114511, April 2023. <https://doi.org/10.1016/j.oceaneng.2023.114511>
6. Hajisharifi A., **Halder R.**, Girfoglio M., Beccari A., Bonanni. D, Rozza. G., "*A LSTM-enhanced surrogate model to simulate the dynamics of particle-laden fluid systems*"., *Computers and Fluids*, 280:106361, August 2024. <https://doi.org/10.1016/j.compfluid.2024.106361>

7. **Halder R.**, Stabile G. and Rozza. G, "*Physics Informed Neural Network Framework for Unsteady Discretized Reduced Order System* ", Computers and Mathematics with Applications, 191, pp 167-187, August 2025. <https://doi.org/10.1016/j.camwa.2025.05.004>
8. Hajisharifi A., **Halder R.**, Girfoglio M., Stabile G., Rozza G., "*A Deep-Learning Enhanced Gappy-POD Method: Application in an Industrial Conjugate Heat Transfer Problem.*" (2025) <http://arxiv.org/abs/2508.20633>
9. **Halder R.**, Stabile G. and Rozza. G, "*Coupling Physics Informed Neural Networks with External Solvers.*" (2025) <http://arxiv.org/abs/2509.24615>

Conferences and Invited Talks

1. **Halder R.**, Stabile G, Reiss G, EBI W, Mugrauer C, Wimmer E and Rozza G, " Projection-Based and Data-Driven Reduced Order Models for Annealing Furnace", presented in Coupled Problems 2025, Villasimius (Sardinia), 25th-28th May, 2025.
2. **Halder R.**, Stabile G., Rozza G., " Physics Informed Neural Network Framework for Full Order and Reduced Order External CFD Solver", presented in CASML 2024, IISC Bangalore, India, 14th-18th December, 2024. https://casml.cc/wp-content/uploads/2024/12/RahulHalder_paper_pinns.pdf
3. **Halder R.**, Stabile G., Codega G., Rozza G., "*Coupling Physics Informed Neural Networks with External CFD Solvers*", presented in ECCOMAS 2024, Lisbon, Portugal, 3rd-7th June, 2024.
4. **Halder R.**, Girfoglio M., Rozza G., "*An Adaptive Regularized Rom for the Quasi-Geostrophic Equations*", presented in SIAM-UQ 2024, Trieste, Italy, 27th February-1st March 2024.
5. **Halder R.**, Hajisharifi A., Girfoglio M., Stabile G., Rozza G., "*A Deep-Learning Enhanced Gappy-POD Method: Application in an Industrial Conjugate Heat Transfer Problem*", presented in M2P 2023, Taormina, Sicily, 30th May-1st June 2023.
6. **Halder R.**, Stabile G., Rozza G., "*Discretized PDE-based Physics Informed Neural Network: Application in Fluid-Structure Interaction Problem*", presented in Coupled 2023, Crete, Greece, 5th -7th June 2023.
7. Tay W.B., Damodaran M., The Z.D. and **Halder R.**, "*Investigation of Applying Physics Informed Neural Networks (PINN) and Variants on 2D Aerodynamics Problems*". Presented in ASME 2020 Fluids Engineering Division Summer Meeting, July 13-15, 2020, Virtual Conference, FEDSM2020-20184, V003T05A055. <https://doi.org/10.1115/FEDSM2020-20184>
8. **Halder R.**, Damodaran M. and Khoo B.C., "*Implementation of a Modal Analysis Platform for Aeroelastic Computation in an Open Source CFD Solver SU2 and Application in Reduced Order Modelling*". Presented in Virtual SU2 Conference 2020, June 10-12, 2020.
9. **Halder R.**, Damodaran M. and Khoo B.C., "*Transonic Flutter Prediction Using Subspace Identification Based Reduced Order Method with Parametric Variation and Flowfield Reconstruction*". AIAA Aviation conference 2019, Texas, Dallas, 17-21 June 2019. <https://arc.aiaa.org/doi/abs/10.2514/6.2019-3390>

Teaching Experience

- Fluid Mechanics: Teaching Assistant in Bachelor Level Course and Laboratory at National University of Singapore.
- Machine Design: Teaching Assistant in Bachelor Level Laboratory at National University of Singapore.
- Fluid Mechanics: Instructor in Evening Classes of Bachelor Level Course at National University of Singapore.
- Scientific ML for Fluid Mechanics: Invited as a guest speaker for 1-hour course in IIT Kanpur.

Other Academic Activity

- Text Book: Currently writing a textbook on Computational Fluid Dynamics with Prof. Gianluigi Rozza
- Mini-symposium Organization: Co-organizer of the mini-symposium coupled conference, Eccomas, 2025, Sardinia, Italy

Reviewer of Journal(s) and Conference Proceeding(s)

AIAA Journal, Proceedings in Applied Mathematics and Mechanics, Physics of Fluid, Ocean Engineering Journal, Nature Scientific Reports, Journal of Numerical Methods in Engineering.

Profiles

- Google Scholar <https://scholar.google.com.sg/citations?user=uIe-AjkAAAAJ&hl=en>
- ResearchGate <https://www.researchgate.net/profile/Rahul-Halder>

References

Prof. Khoo Boo Cheong (PhD advisor)

Professor of Mechanical Engineering and Director Temasek Laboratories, National University of Singapore.

Email id: mpekbc@nus.edu.sg

Webpage: <https://cde.nus.edu.sg/me/staff/khoo-boo-cheong-2/>

Dr. Murali Damodaran (PhD co-advisor)

Retired Adjunct Senior Research Scientist, Temasek Laboratories, National University of Singapore, Singapore and Visiting Professor, Dept. of Aerospace Engineering, IIT Kanpur, India

Email id: tslmura@nus.edu.sg

Webpage: https://temasek-labs.nus.edu.sg/program/program_aerodynamics_tslmura.html

Prof. Gianluigi Rozza (PostDoc mentor)

Full Professor in Numerical Analysis and Scientific Computing at SISSA mathLab, Mathematics Area, SISSA – International School for Advanced Studies, Trieste, Italy.

Email id: grozza@sissa.it

Webpage: <https://mathlab.sissa.it>

Dr. Giovanni Stabile (Collaborator)

Associat Professor at Biorobotics Institute, Sant'Anna School of Advanced Studies, Piazza
Martiri della Libertà, 33, 56127 Pisa, Italy

Email id: [**giovanni.stabile@santannapisa.it**](mailto:giovanni.stabile@santannapisa.it)

Webpage: <https://www.giovannistabile.com/>