Rahul Halder, PhD

Post-Doctoral Researcher
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Research Interests

Fluid-Structure Interaction, Reduced Order Model, Scientific ML, Aeroelasticity, Computational Fluid Dynamics.

Work Experinece

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 - 9.25/10.

2009 - 2013: Bachelor of Engineering, Department of Mechanical Engineering, Jadavpur University, Kolkata, West Bengal, India. CPI - 8.68/10.

Research Topics

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

*Development of Non-Intrusive Data-Driven ROM for **Industrial Applications**. *Discretized Governing Equation-Based Physics Informed Neural Network. *Regularized Galerkin Reduced Order Model for Quasi-Geotropic Equation for **Oceanographic Problems**.

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 Linearized 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-Instrusive 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`

Conferences

1. **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.

2. **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.
3. 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
4. **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.
5. **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

In Preperation

1. 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."*- In Preperation
2. **Halder R.**, Stabile G., Rozza G., *"Physics Informed Neural Network Framework for Unsteady Discretized Reduced Order System."*- In Preperation

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.

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

AIAA Journal, Proceedings in Applied Mathematics and Mechanics, Physics of Fluid, Ocean Engineering Journal.

Profiles

Google Scolar	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)

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 (SSD MAT/08, A1/05) 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)

Assistant Professor (RTD-B) at the University of Urbino "Carlo Bo", Department of Pure and Applied Sciences, Informatics, Italy.

Email id: **giovanni.stabile@uniurb.it**

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