Aditya Raj

PhD student and **Graduate Research Assistant (GRA)** at the Department of Mechanical Engineering at **Virginia Tech.**
Research interests include **chaos** and **nonlinear dynamics, dynamical systems** and **fluid dynamics**.

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🎓 Education

PhD in Mechanical Engineering from Virginia Tech, Blacksburg, USA, *Aug 2021 - Exp May 2026*
Masters in Mechanical Engineering from IIT Dhanbad, India, *Aug 2017 - May 2019*
Bachelors in Mechanical Engineering from MIT Muzaffarpur, India, *Aug 2011 - May 2015*

👨🏽‍💻 Work Experience

Graduate Research Assistant
Paul Research Group, Department of Mechanical Engineering, Virginia Tech, Blacksburg, USA – (May 2022 - Present)

- Currently studying **spatiotemporal chaos** and exploring how spatially extended systems are affected by short- and long-range couplings.
- To that end, I'm exploring **coupled map lattices (CMLs)** and **partial differential equations (PDEs)**. I'm looking at how certain tools from **dynamical systems theory** such as **covariant Lyapunov vectors (CLVs)** can help understand the **chaotic behavior** of these **high dimensional systems**.
- Studying pattern formation in **Rayleigh–Bénard convection** using the **Generalized Swift-Hohenberg equation** and studying how mean flow strength can affect the tangent-space dynamics.
- This is a fully **computational study** that generally involves **numerical computations** of **tangent space equations** of CMLs or PDEs.
- Using CLVs to study the hyperbolicity of the tangent space dynamics and potentially gain some insight about the effective dimension of the system.

Graduate Research Assistant
CEHMS Group, Department of Mechanical Engineering, Virginia Tech, Blacksburg, USA – (Jan 2022 - May 2022)

- Studying **bistable energy harvesting**, especially using the phenomenon of **stochastic resonance**.
- Manufacturing bistable energy harvester capable of snap-through mechanism.
- Performing experiments to characterize the stiffness of bio-inspired bistable energy harvesting.

Graduate Teaching Assistant
Department of Mechanical Engineering, Virginia Tech, Blacksburg, USA – (Aug 2021 - Dec 2021)
GTA in ME 3624 Mechanical Design Lab.

- Conducting laboratory sessions
- Demonstration of experiments
- Grading student report
- Helping students in office hours

Project Assistant III
Aerosystems Laboratory, CSIR-CMERI, Durgapur, India – (Aug 2019 - Mar 2020)
Project: Design of Pressure Regulating and Shut-Off Valve (PRSOV) for the Environmental Control System (ECS) of aircraft.

- Drafting and Solid Modelling.
- Inspection of blueprints.
- Brainstorming for design improvements.
- Mathematical Modeling for flows through orifices.

Teaching Assistant
Department of Mechanical Engineering, IIT(ISM), Dhanbad, India – (Aug 2018 - May 2019)

- Conducting quiz sessions.
- Helping students to solve quiz problems.

🛠️ Skills

MATLAB
I've worked with it for over 10 years. I've used it write my code for numerical analyses of coupled map lattices, partial differential equations and small projects involving computational fluid dynamics such as lid-driven cavity. I've also used it for frequency domain analysis of vibrations of composite beams.

Python
I'm not proficient yet but this is something I like to tinker with in my free time.

Academic writing
I have written a conference paper, worked on several term paper and projects in grad school. Also co-authored a journal paper.

Autodesk Inventor
The 3D modeling tool I'm most proficient in. I have used it at my stint at CSIR-CMERI Durgapur.

ANSYS
Used it for a term project involving the calculations of a fluid flow in a lid-driven cavity.

🏆 Awards

1. GATE Scholarship, Ministry of Human Resource Development, Government of India. (July 2017 - May 2019).

📄 Publications

1. A Raj and M Paul. Exploring the role of diffusive coupling in spatiotemporal chaos (2024). (Accepted for publication in Chaos: An Interdisciplinary Journal of Nonlinear Science).
2. A Raj, J P Varun, and PK Mahato. Fabrication and vibration damping analysis of basalt fiber reinforced composite beam. In AIP Conference Proceedings, volume 2134. AIP Publishing, 2019.

📈 Presentations

- A. Raj and M. R. Paul, *Using Covariant Lyapunov Vectors to Investigate the Role of Spatial Interactions in Chaotic Fluid Systems*, Bulletin of the American Physical Society (2023). Presentation at APS DFD 2023.
- A. Raj and M. R. Paul, *The Spatiotemporal Chaos of Coupled Maps: Insights from the Covariant Lyapunov Vectors*. Presentation at SIAM DS 23 (2023).
- A. Raj and M. R. Paul, *Building a Physical Understanding of Spatiotemporal Chaos using Covariant Lyapunov Vectors*. Presentation at SIAM SEAS (2023).
- A. Raj and M. R. Paul, *Exploring the Spatiotemporal Chaos of Lattices of Coupled Maps with Diffusive and Convective Spatial Interactions*. Poster Presentation in Walter O'Brien Graduate Research Symposium at Virginia Tech (2023).
- A. Raj and M. R. Paul, *Exploring the Role of Spatial Coupling in Spatiotemporal Chaos Using Covariant Lyapunov Vectors*, Bulletin of the American Physical Society (2023). Presentation at APS March Meeting 2023.
- A. Raj and M. R. Paul, *Using Covariant Lyapunov Vectors to Explore Chaotic Dynamics with Long-Range Spatial Coupling*, Bulletin of the American Physical Society (2022). Poster Presentation at APS DFD 2022.

🏛️ Extra-curricular

1. Working on the web presence of grad student org MEGSC (Mechanical Engineering Graduate Student Council) at Virginia Tech. (March 2023 - Present)
2. Served as the president of the grad student org GEA (Graduate Engineering Alliance) at Virginia Tech (Jan 2023 - Dec 2-23)
3. Ranked 1st in a poster drawing competition in undergrad (BTech) at MIT Muzaffarpur.

🤹 Hobbies and interests

Chess, table-tennis, hiking, movies.
