Deepak Somani

Website : https://somani-deepak.owlstown.net

Email : deepak.somani@epfl.ch

Mobile : +41-762707101

Education

- **École Polytechnique Fédérale de Lausanne** — Lausanne, Switzerland
  Ph.D., Materials Science & Engineering — *2023 – present*
  (Laboratory: MADES, Supervisor: Dr. Anirudh Natarajan)
- **Indian Institute of Technology Kharagpur** — Kharagpur, India
  B.Tech M.Tech Dual Degree, Mechanical Engineering — *2018 – 2023*
  (Specialization: Thermal Science & Engineering); CGPA: 9.23/10
- **Jawahar Vidya Mandir** — Ranchi, India
  All India Senior School Certificate Examination (AISSCE); Percentage: 93.4/100 — *2017 – 2018*
- **Bridgeford School** — Ranchi, India
  All India Secondary School Examination (AISSE); CGPA: 10/10 — *2015 – 2016*

Research Experience

- **Carleton University** — Ottawa, Canada
  MITACS Globalink Research Internship, Supervisor: Prof. Reza M. Kholghy — *May 2022 - August 2022*
  Project: Multiscale Modeling of Nickel-Carbon Nanoparticles Formation in Gas Phase
  - Developed an algorithm calculating the Lindemann Index and Potential Energy, defining the melting temperature range for nanoparticles with different configurations and impurity percentages, thereby plotting the phase diagrams
  - Evaluated the XRD patterns and formation & impact of Single-Walled Nanotubes in different nanoparticles
  - Conducted the sintering simulations, mathematically defining a relationship between the characteristic sintering time and the parameters of primary particle diameter, temperature, rotation, and impurity percentage
- **The University of Tokyo** — Tokyo, Japan
  ESEP Remote Research Internship, Supervisor: Prof. Watanabe Satoshi & Prof. Koji Shimizu — *May 2022 - July 2022*
  Project: Thermal Conductivity Calculation of super-lattices of Group-III Nitrides
  - Generated a LAMMPS algorithm for thermal conductivity calculation of monolayered and bulk super-lattices (h-BN/h-AlN/h-GaN), thereby also defining the dependence of heat coefficient on the surface area
  - Assessed the development of NNP potential for group-III nitrides, determined the maximum withstanding temperature, and compared its results to the conductivity calculations from the Tersoff potential
- **Brown University** — Rhode Island, US
  Summer Remote Research Internship, Supervisor: Prof. Brenda Rubenstein — *May 2021 - Dec 2021*
  Project: Molecular modeling of Adsorbate Layers in the Ion-Trapping Quantum devices
  - Modeled the methane & acetylene layer dynamics on gold substrates at different temperatures by running MD simulations on a DFT-derived potential energy surface (PES) by integrating a Python algorithm with LAMMPS.
  - Computed the adsorbate dipole-dipole correlation functions and acquired the dipole-dipole fluctuation spectra through Fourier transformation, thereby analyzing frequency-dependent behavior for predicting the ion-trap noise

  Project: Multilayer Chemical Circuits using Autocatalytic Reactions
  - Constructed a fully cascadable chemical circuit, considering the binary output yielding autocatalytic reaction as standard logic gates, & designed the negation operations using combinations of dual-rail logic & De Morgan's Laws
  - Demonstrated the capability of circuits with experimental execution of the molecular half-adders/subtractors, Gray-code converter, and other combinational networks
- **Indian Institute of Technology Kharagpur** — Kharagpur, India
  Undergraduate Student Researcher, CRED LAB, Supervisor: Prof. Puneet Kumar Patra — *Aug 2019 - May 2023*
  Project: Single-Particle Stirling Engine and Atomistic Heat Engines
  - Devised the atomistic heat engines of Carnot, Otto, & Stirling cycles, evaluated the dependence of their efficiencies on the finite cycle time, system density, and interaction parameter
  - Designed a Stirling engine for a single harmonic oscillator whose stiffness varies with time, associating with different deterministic thermostats
  - Established the Fluctuation Theorem relation by evaluating the probability distribution of the engine's efficiencies

  Project: Thermal Conduction in One-Dimensional Chains

- Simulated for heat conduction in the Fermi-Pasta-Ulam chain to study the effects of non-linear interactions, and established that the heat coefficient varies proportionally with the number of particles as an exponent of 0.3
- Introduced a collision interaction term in $\phi 4$ chains, and found the conductivity to be more stable and linear

Project: Revisiting the Hamiltonian Formulation of the GIK and the restricted GIE Thermostat

- Formalized a theoretical proof for the equivalency of the Gauss' Principle of Least Constraint and Least Action
- Fabricated a derivation for the Hamiltonian of the Gaussian Isokinetic and the restricted Gaussian Isoenergetic thermostat from first principles, extending the proof for non-holonomic constraints

Professional Experience

- **Structural Team Member, AIRAVAT, IIT Kharagpur** *Apr 2020 - May 2021*
  - Modeled the Full Car Analysis for the 3-wheeled 5 kg VTOL model, thereby enabling the decision-making for appropriate suspension selection
  - Performed the Structural Analysis of the chassis, produced the stress-strain analysis of gears and bell cranks, as well as designed the Wing Attachment Brackets
- **Explicit Dynamics Winter Internship, Eleno Energy** *Dec 2020 - Jan 2021*
  - Executed the mini-projects on Crash-Box Analysis, RUPD Energy Absorption Analysis, as well as Alloy-Wheel Impact test as per the Indian Rules & Standards on ANSYS LS-DYNA
  - Simulated the Impact on Armour Plate by Blunt-nose Cylinder Projectile, predicting the residual velocity of the bullet and the transient damage of the plate
- **Structural Summer Internship, Tardid Technologies** *June 2020 - Aug 2020*
  - Applied the Stress and Fatigue Crack-Growth Assessment of Modified Compact-Test Specimens using SIFs as well as the J-integral method on ANSYS Workbench
  - Performed the Fatigue Structural Analysis on the Ship Hull, simplifying the stress history using the Rainflow Counting Method, and predicting the life to about 10^7 cycles

Academic Achievements

- **Doctoral Program offers:** Received Ph.D. offers from EPFL, UPenn, Johns Hopkins, UWM, Penn State, and Purdue, securing external fellowships and scholarships, totaling 11,500 USD.
- **Best Thesis Work:** Endowed with the proficiency of having done the best project work among outgoing Dual Degree graduate students in Thermal Science and Engineering, 2022-23.
- **Department Rank:** Among the top three in a batch of 81 students in the Mechanical Engineering Department of IIT Kharagpur, ranked 1st in Thermal Science & Engineering specialization. Hall Blue
- **IIT KGP Foundation of USA Internship Award:** Selected for the IIT KGP Foundation of USA Internship Award amounting to 4000 USD in 2022 for pursuing a summer internship at Pennsylvania State University, Philadelphia, USA
- **MITACS Programme:** Part of the MITACS GRI cohort of 2022 to pursue a summer research internship at Carleton University, Ottawa, Canada
- **ESEP Programme:** Received an opportunity to be part of the cohort of 6 students to pursue a summer research internship at the School of Engineering, the University of Tokyo, in 2022
- **Merit-Cum-Means Scholarship, IIT Kharagpur:** Awarded this scholarship for being academically excellent, covering the tuition fees, from the second to the fourth year of undergraduate studies (2019-21), at IIT Kharagpur.
- **Joint Entrance Examination (JEE):** Ranked 1533 (99.042 percentile) and 873 (99.921 percentile) in India in JEE Advanced and JEE Main respectively, for the engineering entrance examinations in 2018.

Publications & Patents

- **Journal Article:** [Under review] **Deepak Somani**, Puneet Kumar Patra, Baidurya Bhattacharya; Revisiting the Hamiltonian Formulation of the Gaussian Isokinetic and the restricted Gaussian Isoenergetic Thermostat, International Journal of Non-linear Mechanics; 2023
- **Journal Article:** [Under preparation] **Deepak Somani**, John Pham, Jacob Rosenstein, Sherief Reda, Eunsuk Kim, and Brenda M. Rubenstein; "Multilayer Chemical Circuits using Autocatalytic Reactions"; 2023
- **Patent:** [Under review] **Deepak Somani**, John Pham, Jacob Rosenstein, Sherief Reda, Eunsuk Kim, and Brenda M. Rubenstein; "Improved methods of Chemical Computation"; 2023
- **Conference Paper:** [Under preparation] **Deepak Somani**; "Calculation of Configurational Temperature for Small Equilibrium Systems"; 2023

Mentorships & Volunteer Activity

- **Research Team Mentor:** Mentored a group of six freshers (2020-21) about the research work being done in the Structural team at AIRAVAT, IIT Kharagpur. Two of them are leading the team now.
- **Covid Volunteer:** Participated as a volunteer in the Marwari Yuva Manch COVID program, Ranchi, to help organize campaigns providing vaccines to required people and food to stray dogs.
- **Teaching Assistant:** Assisted the professors in the coursework of "Applied Thermo-Fluids" in the Autumn semester of 2022 by tutoring and designing assignments for the fourth-year undergraduate students of the department.

Relevant Coursework

Introduction to Nano-Science and Technology, Microfluidics, Thermodynamics, Convective Heat and Mass Transfer, Computational Fluid Dynamics, Finite Element Methods in Engineering, Probability & Statistics, Materials Engineering, Mechanics of Solid, Computational Methods in Thermal Engineering

Skills

- **Programming Languages:** Python, C, MATLAB, Octave
- **Research Packages:** LAMMPS, VASP, VMD, OVITO, ANSYS, Autodesk Fusion 360, Solidworks, COMSOL, LaTeX, OpenSim, Symbols
- **Scripting Languages:** Shell Script (Linux)
- **Subjects outside coursework:** Statistical Mechanics, Density Functional Theory, Quantum Mechanics, Classical Mechanics, Molecular Dynamics, Machine Learning, Neural Networks, Engineering Simulations, Explicit Dynamics