

# Shrey Sahai Gupta

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## Profile Summary

Doctoral student at IISc, Bangalore | 4+ years of research experience | **System-level modeling & control** of sCO<sub>2</sub> cycles | Off-design analysis, **transient simulation**, reduced order models | **Advanced control** (MPC) for thermal systems

## Education

Ph.D., Indian Institute of Science (IISc), Bangalore Mechanical Engineering   GPA: 9.7/10	Aug 2021- Present	B.Tech., Indian Institute of Technology, Ropar Mechanical Engineering   GPA: 8.76/10	2016-2020
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## Research Experience

**Doctoral Researcher, Thermal Systems Laboratory, IISc Bangalore** | Research Supervisor: *Prof. Pramod Kumar*

Thesis: *Numerical Modeling and Control of Supercritical Carbon Dioxide (sCO<sub>2</sub>) Power Cycles*

- Formulated **first-principles** models for sub **10 MW** recuperated sCO<sub>2</sub> Brayton cycles, comprising 2 radial turbomachines, 3 **microchannel** heat exchangers and 17 state variables, with systematic component matching for **real-gas turbomachinery**.
- Implemented map-based compressors/turbines and **1D dynamic heat exchanger** models, validated against steady-state and transient benchmarks (**< 4% deviation**).
- Derived transfer-function models via step testing of **inventory** and **turbine-bypass** actuators, revealing **non-minimum phase** behavior and characteristic time constants (**~ 7s**)
- Implemented **MPC** for load regulation, using a sampling frequency of **0.5 Hz**, achieving **99.6% reference tracking** accuracy during **~10%** load ramps in detailed time-domain simulations.
- Extended methodology to **waste heat recovery bottoming cycles** coupled to a **~25 MWe gas turbine**, resolving distinct transient mechanisms under **constant vs-controlled CO<sub>2</sub> inventory**.

## Publications

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|--|-----------------------------------|-------------------------------|------|
| Model Predictive Control For sCO <sub>2</sub> Power Cycles ( <i>Submitted</i> )            | S. S. Gupta, P. Kumar             | ASME Turbo Expo, Milan, Italy | 2026 |
| Dynamic Operation of sCO <sub>2</sub> Gas Turbine Bottoming Cycles ( <i>Submitted</i> )    | S. S. Gupta, P. Kumar             | ASME Turbo Expo, Milan, Italy | 2026 |
| Inventory Control Options for Transient Operation of sCO <sub>2</sub> Brayton Cycles       | S. S. Gupta, P. Kumar             | J. Eng. Gas Turbines Power    | 2026 |
| Control Strategies in sCO <sub>2</sub> Brayton Cycles                                      | S. S. Gupta, P. Kumar             | IMECE-India, Hyderabad        | 2026 |
| Off-Design Performance of sCO <sub>2</sub> WHR Cycles: Implications of System Design       | S. S. Gupta, P. Kumar             | Turbo Expo, Memphis, US       | 2025 |
| Optimal Part-Load Performance of sCO <sub>2</sub> Brayton Cycles During Inventory Control, | S. S. Gupta, P. Kumar             | J. Eng. Gas Turbines Power    | 2025 |
| Cold Flow Test Conditions & Fluid Selection for 60-kW sCO <sub>2</sub> Turbine             | S.J. Hoque, S. S. Gupta, P. Kumar | Turbo Expo, London, UK        | 2024 |

## Technical Skills

**System Modeling & Simulations:** Transient analysis | Off-design performance evaluation **Control Systems:** Model Predictive Control (MPC) | Classical PID control | Control-oriented modelling **Software & Engineering Tools:** ANSYS (Fluent, Twin Builder) | Modelica **Programming:** Python | MATLAB | C++ **Data Analysis & Visualization:** Matplotlib | MS Excel

## Work Experience

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|--|---------------------|
| <b>Hindustan Petroleum Corporation Ltd.</b>   Operations Officer   Bathinda, India                           | Sep 2020 – Jun 2021 |
| • Ensured uninterrupted fuel dispatch during COVID-19 supplying Punjab, Haryana, HP & J&K                    |                     |
| • Executed ops, safety, OISD-2020 audit, 20% ethanol blending, and led transition to bottom-loading systems. |                     |
| <b>Diverta Inc.</b>   Software Development and AI Intern   Tokyo, Japan                                      | May – Jul 2019      |
| • Developed multi-tag select web component for RCMS website on VueJS   |                     |
| • Developed auto-tagging ML model to cluster similar-looking customers in shop footage                       |                     |
| <b>Volvo Eicher Commercial Vehicles Ltd</b>   Mechanical Engineering Intern   Pithampura, India              | May – Jun 2018      |
| • Conducted feasibility study, process scheduling, cost estimation, etc. for elevation of an Air Supply unit |                     |

## Projects

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| • <b>Potential flow simulation past cascades</b>   Prof. Raghuram Govardhan                                | Aug - Dec 2021      |
| Inviscid flow field calculation past linear cascade using vortex panel method and conformal mapping        |                     |
| • <b>Mechanical tissue deformation during thermal ablation</b>   Prof. Ramjee Repaka                       | Aug 2019 – Jul 2020 |
| Estimated tissue deformation by incorporating three-state protein denaturation in Penne's bioheat equation |                     |
| • <b>Ergonomic Crutches Design</b>   Inter IIT Tech Meet   | Dec 2018            |
| Design for patients with prolonged usage and therefore at high risk of crutch palsy                        |                     |

## Awards & Fellowships

- Prime Minister Research Fellow, Government of India • Agastya Science Communication Fellow, 2023 • Top 5 pitches, Falling Labs, Bengaluru 2023
- Department Rank: 2 IIT Ropar • Silver Medal, BeTiC Challenge, Inter IIT-Tech Meet 2018

## Coursework

Fluid Mechanics • Thermodynamics • Convective Heat Transfer • Turbomachine Theory • Boundary Layer Theory • Control System Design • Thermal System Design • Gas Dynamics

## Presentations & Professional Activities

- Presented Research at ESTIC 2025 at Bharat Mandapam, New Delhi • Chair, Student Review Initiative, ASME International Gas Turbine Institute Turbo Expo • Student Reviewer and Liaison, sCO<sub>2</sub> Committee at Turbo Expo in Memphis, USA and Milan, Italy • Delegated IISc, Bangalore at Tech Exhibition, G20 Clean energy meet 2023 • Teaching Assistant at NPTEL for courses like Applied Numerical Methods, Gas Dynamics and Transport Processes.