Abhishek Srivastava

Charged-Particle Transport / Multiphase Flow & Electrostatics / Machine Learning / Uncertainty Quantification

abhiresearch24@gmail.com Website LinkedIn GitHub ORCID Google Scholar

Research Profile

Researcher in charged-particle transport and multiphase flow (Ph.D., Mechanical Engineering, IIT Delhi, 2026), working on the transport, deposition and capture of charged particles in gas flows. My doctoral research combined high-fidelity multiphysics simulation (CFD, electrostatics and particle tracing) with explainable machine learning and surrogate-assisted multi-objective optimization to understand particle–surface rebound and to design compact electrostatic particle collectors, published in *Powder Technology* and the *Journal of Electrostatics*. At IIT Palakkad I develop Bayesian inference and uncertainty-quantification methods for physics-based inverse problems. I aim to bring this combination of particle dynamics, simulation and probabilistic machine learning to multiphase, aerosol and particle-technology problems.

Education

Indian Institute of Technology Delhi *Jan. 2020 – Jul. 2026*
Ph.D., Mechanical Engineering (Fluid Mechanics and Thermal Sciences) GPA: 8.79
Thesis: Modelling Charged Particle Dynamics and Optimizing its Collection Efficiency by Spherical Collector Using Machine Learning *Defended: Jul. 2026*

Maulana Azad National Institute of Technology, Bhopal *Jul. 2017 – May 2019*
M.Tech., Maintenance Engineering GPA: 8.16

Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh *Aug. 2011 – Jun. 2015*
B.Tech., Mechanical Engineering

Journal Publications

[J1] **A. Srivastava**, D. Biswal, B. Ray, M. Kumar, D. Dasgupta. "Influence of nonuniform electric field due to a spherical collector on the particles' dynamics in quiescent air." *Journal of Electrostatics*, 129 (2024) 103916. [DOI]

[J2] **A. Srivastava**, S. Kandpal, B. Ray, M. Kumar, D. Dasgupta. "Analyzing the impact of charge particle rebound on spherical collector efficiency via explainable machine learning." *Powder Technology*, 469 (2025) 121803. [DOI]

Under Review / Submitted

[R1] **A. Srivastava**, S. Kandpal, B. Ray, M. Kumar, D. Dasgupta. "Machine learning-based regime identification and size-resolved optimization of charged-particle capture and rebound on spherical collectors." *Powder Technology* (submitted).

[R2] **A. Srivastava**, A. Hazra, R. Dubaku. "Conditioning-dependent variational inference for uncertainty quantification in physics-based inverse problems." *Probabilistic Engineering Mechanics* (under review). [arXiv]

Research Experience

Doctoral Researcher, Department of Mechanical Engineering, IIT Delhi *Jan. 2020 – Jul. 2026*
Supervisors: Dr. Bahni Ray and Dr. Mayank Kumar

- Developed a high-fidelity multiphysics framework (CFD + electrostatics + particle tracing, COMSOL) to study charged-aerosol transport, deposition and capture on charged spherical collectors [J1].
- Developed an interpretable machine-learning framework (LightGBM, SHAP, PDP, ALE) that identified the dominant physical mechanisms governing charged-particle rebound and collection efficiency [J2].
- Developed a clustering-guided, surrogate-assisted multi-objective optimization pipeline (K-means, NSGA-II, TOPSIS) for size-resolved design of compact, ozone-free electrostatic particle collectors that maximize capture while limiting rebound [R1].

Project Associate, Department of Mechanical Engineering, IIT Palakkad *Feb. 2026 – Present*
Mentor: Dr. Arijit Hazra

- Developing variational-autoencoder-based posterior approximation for Bayesian inverse problems in heat conduction, benchmarked against MCMC reference posteriors [R2].
- Derived a Fisher-Information-Matrix-based analysis explaining when amortized variational posteriors under- or over-estimate uncertainty [R2].
- Performing identifiability analysis and optimal sensor placement for inverse heat transfer in jet impingement cooling using physics-informed surrogates (PINN/PIKAN).

Research Expertise

Particles & Simulation	CFD; multiphysics modelling; electrostatics; Lagrangian particle tracing; fluid–particle and particle–surface interactions; COMSOL Multiphysics; FEniCS
Machine Learning	Surrogate modelling; physics-informed ML (PINN, PIKAN); generative models (VAE); explainable AI (SHAP, PDP, ALE)
Optimization	NSGA-II; multi-objective and surrogate-assisted optimization; Bayesian optimization; clustering-guided design
Bayesian / UQ	Bayesian inverse problems; MCMC (Adaptive Metropolis, HMC); variational inference; Fisher-information analysis
Computing	Python (TensorFlow, Scikit-learn, NumPy, SciPy, Pandas); parallel computing; Linux; Git

Conference Proceedings and Presentations

- **A. Srivastava**, B. Ray, M. Kumar. "Numerical investigation on deposition process of polydisperse dust particles on charged spherical pendant collector." International Workshop on Sustainable Energy, Power and Propulsion (IWSEPP), IIT Kanpur, Jan. 2024. *Best Technical Interaction Award.*
- **A. Srivastava**, et al. "Dynamic characteristics of submicron particle deposited on the charged spherical collector." Conference on Fluid Mechanics and Fluid Power (FMFP), IIT Roorkee, Dec. 2022. Springer Proceedings. [DOI]
- **A. Srivastava**, et al. "Electrospray based air pollution mitigation: droplet and particle interaction." COMPOLL, IIT Delhi, Nov. 2022.

Awards, Service and Teaching

- **Reviewer:** *Physics of Fluids* (AIP Publishing).
- **Best Technical Interaction Award**, IWSEPP 2024, IIT Kanpur.
- **MHRD Fellowship**, Government of India, for Ph.D. research and for M.Tech. (GATE 2016).
- **Certificate of Appreciation** from the Director, IIT Delhi, for organising the Structured Open House (Feb. 2024).
- **Teaching Assistant**, IIT Delhi: Intermediate Heat Transfer; Advanced Thermodynamics; Heat Transfer Laboratory; Engineering Drawing Laboratory.

References

Dr. Bahni Ray
Associate Professor
Mechanical Engineering
IIT Delhi
bray@mech.iitd.ac.in
Faculty Profile

Dr. Mayank Kumar
Associate Professor
Mechanical Engineering
IIT Delhi
kmayank@mech.iitd.ac.in
Faculty Profile

Dr. Arijit Hazra
SERB Ramanujan Fellow
Mechanical Engineering
IIT Palakkad
ahazra@iitpkd.ac.in
Faculty Profile