Amit K Singh

Contact Information

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Research Interests

Physics-based Simulation, Inverse Problems, Scientific Machine Learning, Data Assimilation, Numerical Simulations, Optical Diagnostics, Image Processing

Education

Pennsylvania State University — University Park, PA
PhD, Mechanical Engineering — Est. 6/2027
- Thesis: Development and Deployment of 4D Emission Tomography for Combustion
- Advisor: Samuel J Grauer
- GPA: 4.00

India Institute of Technology Kanpur — Kanpur, India
MTech, Aerospace Engineering — 31/5/2018
- Thesis: Study of the Effect of Roughness on Gas-Surface Interactions
- Advisor: Rakesh Kumar Mathpal
- GPA: 3.90

BTech, Aerospace Engineering — 1/6/2017
- GPA: 3.44

Awards & Scholarships

Academic Excellence Award in two consecutive years — 2015, 2016
Indian Institute of Technology, Kanpur India

Merit-cum Means (MCM) Scholarship — 2015-2017
Indian Institute of Technology, Kanpur India

Boeing Technical Internship Program — 2016
Boeing International Corporation India Private Limited

Research Projects

Pennsylvania State University, University Park, PA

4D Emission Tomography for Combustion — 1/2024–Present
- Developed Neural-Implicit Framework for 4D tomographic imaging of detonation waves
- Developed observation operator for chemiluminescence that accounts for depth-of-field effects
- Implemented efficient sampling method for forward and inverse chemiluminescence imaging
- Validated framework using synthetic chemiluminescence images of a turbulent CH_4/air flame

Data Assimilation Framework for Combustion — 1/2023–9/2024
- Developed PINN data assimilation framework for spectral emissions from water vapor
- Modeled physics loss in 1D dimensional flame with single-step chemistry based on CANTERA
- Included mixture averaged model to estimate transport properties including thermal conductivity, mixture diffusivity and viscosity

Aggregate Loss Data Assimilation for BOS 5/2022–12/2023

- Developed optimization-based data assimilation framework for BOS
- Implemented compressible FV-CFD solver in differentiable programming environment

Predictive Modeling of Cardiovascular Health: Leveraging Machine Learning for Early Detection and Prevention of Heart Diseases 8/2023–12/2023

- Developed a hybrid Convolutional Recurrent Neural Network (CRNN) in PyTorch for classifying 7 types of cardiac arrhythmias with 12-lead ECG database of 10k patients
- Implemented a novel architecture combining CNN blocks with skip connections and bidirectional LSTM layers
- Achieved 90.14 accuracy using an ensemble model with probability-based voting
- Demonstrated improved performance by using multi-lead ECG data compared to single-lead approaches

Indian Institute of Science, Bengaluru, India

Synchronization Dynamics in a Rotating Swirl Combustor 11/2018–3/2020

- Studied thermoacoustic instability mitigation in an unstable laboratory scale combustor, using a robust approach of a rotating swirler
- Involved in performing combustion experiments with chemiluminescence Imaging

Indian Institute of Technology Kanpur, Kanpur, India

Study of the Effect of Roughness on Gas-Surface Interactions 7/2017–6/2018

- Characterized surface roughness by incorporating protrusions of various geometrical shapes
- Applied the Direct Simulation Monte Carlo (DSMC) method to evaluate the effective Tangential Momentum Accommodation Coefficient (TMAC) considering roughness effects
- Developed an empirical model linking effective TMAC to roughness parameters using supervised machine-learning techniques

Teaching Experience

TA	Computational Tools (ME 330)	Penn State	Fall 2022
TA	Introduction to Combustion (ME 430)	Penn State	Fall 2021
TA	Experiments in Aerospace Engineering (AE 251)	IIT Kanpur	Spring 2017

Journal Publications

Published

J1. KK Kammara, R Kumar, **AK Singh**, and AK Chinnappan, "Systematic direct simulation Monte Carlo approach to characterize the effects of surface roughness on accommodation coefficients," *Phys Rev Fluids* **4**, 123401 (2019). doi:10.1103/PhysRevFluids.4.123401

Conference Contributions

Papers

C3. **AK Singh**, JP Molnar, M Gomez, RT Fievisohn, and SJ Grauer, "Towards 4D emission tomography of reacting waves," *AIAA SciTech 2025 Forum*, Orlando, FL, Jan 6–10, 2025. doi:10.2514/6.2025-1056

C2. RA Peck Cowles, JP Molnar, **AK Singh**, and SJ Grauer, "Tomographic background-oriented schlieren facility for buoyancy-driven flows and flames," *AIAA SciTech 2025 Forum*, Orlando, FL, Jan 6–10, 2025. doi:10.2514/6.2025-1058

Abstracts

C1. **A Singh**, JP Molnar, SJ Grauer, and GS Sidharth, "Aggregate loss data assimilation (ALDA) for supersonic BOS," *75th Annual Meeting of the APS Division of Fluid Dynamics*, Indianapolis, IN, Nov 20–22, 2022. Link