Rakesh Naik

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Research Summary

Experimental photonics researcher specializing in plasmon-enhanced spectroscopy and machine learning-integrated optical diagnostics. My work focuses on designing nano-engineered SERS substrates using glancing angle deposition (GLAD) and developing data-driven spectral classification frameworks for rapid respiratory virus detection. I integrate nanofabrication, Raman spectroscopy, electromagnetic simulations (COMSOL), and supervised learning pipelines to build clinically translatable diagnostic platforms. My long-term research vision lies at the intersection of plasmonics, nanophotonics, and intelligent optical sensing systems for biomedical and environmental applications.

Education

PhD (Ongoing) Aug 2024 – Present
Centre for Photonics and Quantum Communication Technology, IIT Roorkee, India

BS-MS (Dual Degree) in Physics 2017 – 2022
IISER Berhampur, India
CGPA: 9.25 / 10 (Distinction)

Research Experience

Machine Learning-Enabled SERS Platform for Respiratory Virus Detection
Supervisor: Dr. Sachin Kumar Srivastava 2023 – Present

- Fabrication of nano-sculptured thin films (nSTFs) via GLAD-based thermal evaporation for plasmonic enhancement.
- Developed standardized SERS spectral database for Influenza A, SARS-CoV-2 (Delta/Omicron), RSV, and Rhinovirus.
- Designed ML pipelines for spectral preprocessing, feature extraction, classification, and cross-validation.
- Integrated automated GUI-based diagnostic system with report generation.
- Performed electromagnetic simulations using COMSOL Multiphysics for near-field optimization.
- Contributing to clinical validation against RT-PCR confirmed samples.

Master's Thesis: Detector Simulations for Electron-Ion Collider (EIC) 2021 – 2022

- Simulated $e + p$ collisions using PYTHIA and conducted detector-level analysis.
- Performed feasibility studies for proposed Time-of-Flight detector systems.
- Analyzed mid-rapidity particle spectra relevant to baryon transport physics.

International Academic Exposure

Sakura Science Exchange Program (Japan) 2025

- Selected participant in the Sakura Science Program promoting Indo-Japan scientific collaboration.
- Engaged in laboratory visits, research discussions, and academic exchange in advanced photonics and nanotechnology.
- Explored collaborative research opportunities in plasmonics and optical sensing technologies.

Technical Expertise

Nanofabrication: GLAD thin films, plasmonic nano-structures
Optical Techniques: Raman Spectroscopy, SERS, spectral data analysis
Simulation: COMSOL Multiphysics, Geant4, ROOT, PYTHIA 6/8
Programming: Python, C/C++, MATLAB
Machine Learning: Scikit-learn, supervised classification, spectral preprocessing
Scientific Tools: LaTeX, Autodesk Fusion 360

Research Interests

Plasmonics | Nanophotonics | Intelligent Optical Sensing
Machine Learning for Spectroscopy | Biosensing Platforms
Translational Photonic Diagnostics

Selected Academic Activities

ALICE-India School on Quark-Gluon Plasma (2021)
Software Tools in Experimental High Energy Physics (2021)
International Conference on Advances in Functional Materials (2020)

References

Available upon request.