Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2024-02-22

Project Proposal for Ph.D.

Project Details	
Project Title	Development and Application of High Biocompatible FITC-Conjugated Nanoparticles for Advanced Cell Labeling and Plant Stress Detection under Toxic Exposure Using Explainable Deep Vision framework.
Project Summary (Minimum 500 and maximum 2000 characters)	The application of nanotechnology in biological and agricultural sciences has paved the way for innovative tools to study cellular dynamics and environmental responses in real-time. Among the various nanomaterials, high biocompatible fluorescein isothiocyanate (FITC)-conjugated nanoparticles (FITC-NPs) have gained prominence due to their superior optical characteristics, high contrast visualization, elevated sensitivity, affordability, and ease of manipulation, which makes it an invaluable tool for research and offering insights into cellular processes and stress detection at different resolutions. Some of the FITC-NPs like FITC-SiO_2 NPs have been used in biomedical imaging and facilitate effective cell labelling in diverse in vitro models. The similar properties will be leveraged for developing suitable NPs for biological applications having chemical stability, optical transparency, biocompatibility, and amenability to functionalization for monitoring physiological stress responses in plants exposed to various environmental toxins using selected nanoparticles. A specific challenge in plant stress identification based on visual symptoms in either leaves, roots, or any other part of the plant is the lack of rapid analytical testing techniques or the ability to access qualitative methods. Primarily, a plant's stress can be detected through manual activities by a trained pathologist. However, these methods are time-consuming and suffer from inter and intra-rater variabilities. To address these issues, the stress responses in plant cells, both in vitro and invivo, will be detected through the concept of explainable deep machine learning at different stages of absorption of FITC-NPs by plants. The aim of this study is to develop the process of plant stress identification, classification, and quantification and also to explain which visual symptoms are used to make predictions. The dataset for the deep machine vision techniques will represents a diverse array of symptoms across biotic (e.g., fungal and bacterial diseases) and abiotic (e.g., nutrient deficiency and chemical injury) stresses.

Ph.D. Supervisors

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Prof Kavya Dashora	CRDT	kdashora@rdat.iitd.ac.in
Supervisor 2	Dr. Ranjeet Kumar Rout	Department of CSE, NIT Srinagar, J&K, India	ranjeetkumarrout@nitsri.ac.in

Project requirements (Student qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- MTech/MSc (with National level exam qualified) in Physics/ nanochemistry/ biotechnology/ Computer Science
- Candidates should have interest in interdisciplinary learning
- Preference will be given to candidates having their own fellowship.

Source of fellowship/funding (CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)
Candidate with his/her own fellowship/ Institute Fellowship

Role of Faculty Members involved:	
Supervisor-1	Prof Kavya Dashora: developing nanoparticles, testing on plant cells invitro and invivo, toxicity analysis, toxicity grading
Supervisor-2	Dr. Ranjeet Kumar Rout: Data preprocessing, Feature extraction using deep vision models, explanation of visual symptoms for stress detection.