Indian Institute of Technology Delhi
School of Interdisciplinary Research (SIRe)

SIRe Project Number
2023-01-38
(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details	
Project Title	**Spectral Delineation of Plant Alkaloids using Hyperspectral Imaging Technology and Machine/Deep Learning**
Project Summary (Minimum 500 and maximum 2000 characters)	Hyperspectral imaging technology has the untapped potential to generate spectral signatures of various plants and vegetation attributes such plant alkaloids in a complex agricultural environment. In India limited studies have been carried out for hyperspectral imaging-based precise crop characterisation at regional scale incorporating the field level data for simulation modelling. Primarily, it is due to the technological challenges such as availability of hyperspectral data covering large areas and technical skills for analysis of such high-volume data, robust deep learning (AI) algorithms, development of suitable models etc. The recent advancement in satellite hyperspectral remote sensing technology provides a unique opportunity to precisely characterise and monitor physical-chemical properties of plant alkaloids in an efficient and economic manner. Hyperspectral imaging is typically defined as a remote sensing technique, which acquires hundreds of contiguous narrow waveband images in the visible and infrared regions of the electromagnetic spectrum. Since spectra of different species changes over various wavelengths, it has the capability to distinguish among agricultural crops/plants, allowing identification and characterization of their bio-physical parameters. Apart from traditional strategic applications, this technique is now being explored for precision farming, soil and vegetation bio-chemical mapping, soil microbial community analysis, mineralogy, environmental degradation/pollution monitoring and in many more interdisciplinary domains worldwide. Analysis of plant alkaloids in different topographic, climatic conditions and field configurations are very crucial for development of an efficient detection mechanism. However, intense field surveying over large area, difficult terrains and spectral mixing with other crops are most challenging tasks for such analysis. Therefore, the proposed mechanism of plant alkaloids spectral characterization using hyperspectral images and machine/deep learning has immense potential in providing reliable plant alkaloids mapping, prediction, and attribution.

PhD Supervisors			
Role	**Faculty**	**Academic Unit in IITD/Institute/University**	**Email ID (Official)**
Supervisor 1	Prof. Shilpi Sharma	Biochemical Engineering and Biotechnology	shilpi@dbeb.iitd.ac.in
Supervisor 2	Prof. Niladri Chatterjee	Joint Prof. at Department of Mathematics and Yardi School of AI	niladri@maths.iitd.ac.in

Project requirements (Student qualifications, experience required, etc.)

- BE / B.Tech in Electrical Engineering / Biochemical Engineering / Biotechnology or M.Sc.in Agriculture / Botany / Cyber Forensics & Information Security / Remote sensing & GIS / Geoinformatics.

Source of fellowship/funding

(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with own funding on part-time basis.

Role of Faculty Members involved:

The proposed research work is truly interdisciplinary in nature, where the expertise of the collaborators is complementary. It integrates spectra-based characterization of plant alkaloids with laboratory parameters for model development, facilitating hyperspectral image based mapping of large fields for reliable detection, prediction, and attribution. Prof. Shilpi Sharma (DBEB, IITD) has expertise in analysis of soil physio-chemical parameters and their correlation with plant health parameters. Her team is working on complex analysis of plant-soil interactions using molecular microbiology approaches. On the other side, Prof. Niladri Chatterjee (Joint Prof. at Department of Mathematics and Yardi School of AI, IITD) has outstanding expertise in the domain of deep learning (AI/ML) and statistical techniques. His expertise is significant for image processing, spectral signature matching and modelling part. This collaboration would help to develop a model for plant alkaloids mapping using hyperspectral imaging technology, where accessibility poses a major challenge.