



Project Proposal for Ph.D.

Project Details	
Project Title	Integrating spatial biology to dissect tumor heterogeneity
Project Summary (Minimum 500 and maximum 2000 characters)	Unraveling tumor heterogeneity—which includes variations within a single tumor and differences between patients—remains a significant challenge in oncology, impacting cancer diagnosis and treatment methods. Traditional techniques often provide an oversimplified, generalized perspective of tumor biology. However, recent advancements in spatial biology offer dynamic insights into the spatial organization of cells within the tumor microenvironment. This interdisciplinary PhD project seeks to leverage spatial biology data from our in-house experiments (SK Lab), along with publicly accessible databases, to investigate tumor heterogeneity across various clinical stages—biopsy, post-chemotherapy, and recurrent tumors. By focusing on unraveling the complex networks of immune signatures and perfusion impacts on tumor heterogeneity, this research will benefit from the combined expertise of a cancer biologist (SK Lab) and a computational scientist (VR Lab). Objectives: - To map the spatial organization of tumor cell populations and components of the microenvironment across biopsy, chemo-treated, and recurrent tumor samples. - To identify and characterize immune landscapes within tumors and simulate/map changes in response to treatment. - To analyze perfusion patterns and their association with tumor heterogeneity and patient prognosis. Methodology: - Sample Collection and Preparation: Utilize spatial-omics data derived from our lab's experiments on human tumor samples and incorporate publicly available databases for single-cell RNA-sequencing and spatial-omics. - Computational Integration: Develop computational models to integrate and analyze spatial data, with an emphasis on identifying key patterns of heterogeneity. Employ stochastic simulation and machine learning algorithms to predict treatment outcomes and identify potential therapeutic targets. Expected Outcomes: This project anticipates the creation of detailed spatial maps that underscore tumor heterogeneity and distinguish distinct cellular niches. Insights into immune signatures and meta-modules will deepen the understanding of immune evasion mechanisms and perfusion-dependent changes within the tumor microenvironment.

Ph.D. Supervisors			
Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Saran Kumar	KSBS, IITD	ksaran@iitd.ac.in
Supervisor 2	Varun Ramamohan	DME, IITD	varunr@mech.iitd.ac.in

Project requirements (Student qualifications, experience required, etc) *The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)
- A Master's degree in a relevant field such as Cancer Biology, Computational Biology, Bioinformatics, Molecular Biology, or a related discipline. Candidates with a strong background in both the biological sciences and computational methods will be highly preferred. - Proficiency in bioinformatics and computational analysis, including experience with programming languages such as Python or R.

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	Saran Kumar: Responsible for designing and supervising experiments to generate spatial biology data from patient tumor samples. Provide expertise in cancer biology to interpret experimental results and guide research hypotheses
Supervisor-2	Develop and apply computational models to analyze the spatial data generated by SK Lab. This includes integrating spatial-omics and single-cell RNA-sequencing data to uncover patterns of tumor heterogeneity.