PROJECT LIST

**Aloke Kumar**  [http://www.kumarlab.com/](http://www.kumarlab.com/)

**Title:** Biomineralization by bacteria - usage as a waste management technique.

Biomineralization refers to the process of mineral precipitation due to chemical alteration of the environment induced by the life processes. Many organisms are capable of this phenomena, and even the diminutive bacteria is able to achieve this. For unicellular organisms such as bacteria, the biomineralization process can be either extracellular or intracellular. Biomineralization is possibly one of the largest ‘manufacturing’ processes undertaken by Earth and is closely associated with the advent of life on this planet. Can we use aspects of this towards waste management and carbon sequestration?

**Ambarish Ghosh**  [http://www.cense.iisc.ac.in/ambarish/](http://www.cense.iisc.ac.in/ambarish/)

**Title:** Deep tissue imaging of magnetic nanorobots Description.

The project will comprise of combining imaging modalities to visualize the motion of magnetic nanorobots inside an animal tissue, with the aim of improving the depth of imaging. Both experimental and programming skills will be necessary for carrying out this research project.

**Bhushan Toley**  [http://toleylab.weebly.com/](http://toleylab.weebly.com/)

**Title:** Design of flow control tools for paper-based microfluidic devices.

Paper-based analytical devices have recently become popular for conducting medical diagnostic tests at a low cost near a patient’s bedside. As a part of expanding the capabilities of paperbased analytical devices, we are interested in designing new flow-control tools, e.g. timers, valves, diodes etc. Specifically, we are interested in integrating low-cost electronic components into paper-based devices to enable better flow control. The summer intern involved in this work will get hands-on experience with fabricating paper-based devices and conducting analytical chemistry in such devices.

**Biramjit Basu**  [http://mrc.iisc.ernet.in/~bikram/](http://mrc.iisc.ernet.in/~bikram/)

**Title:** Development of Carbon nanotube (CNT) filled Polyvinylidene difluoride (PVDF) for tissue engineering application.

In the line of BSSE BEST programme, the summer intern will be working on the fabrication of PVDF/CNT nanocomposite using melt compounder. The fabrication process will be optimized to obtain higher beta-phase which is responsible for piezoelectricity of the polymer. The dielectric property of the
nanocomposite will be studied in comparison to virgin PVDF. The porosity of the compression moulded PVDF nanocomposite will be measured using gas-pycnometer. The effect of DC electric field on the pH of cell culture media will be studied for the cytocompatibility assessment of PVDF nanocomposite. The change in surface energy upon incorporation of CNT in the PVDF matrix will be determined using contact angle goniometer.

Chandrachekar S  https://sites.google.com/site/chandrasekharseelamantula/home

**Topic 1:** Deep Learning Tools for Healthcare Applications.

The objective is to develop deep learning tools and techniques for gastrointestinal disease classification starting from endoscopy images. The intern is expected to have a basic understanding of image processing or be willing to learn and pick-up the required basics. Programming expertise in Python/Matlab is mandatory. Exposure to deep learning tools is desirable but not mandatory.

**OR**

**Topic 2:** Development of a Handheld 3-D Scanner.

The objective here is to develop a handheld 3-D scanner using the principles of structured light projection (profilometry). We have an ongoing project in our lab on this topic and the intern would be expected to contribute to an aspect of the project either on the hardware side or on the software aspects. Hardware-level contributions include the design and fabrication of gratings that can be fixed on to mobile phone cameras. Software-level contributions include the development of Apps for the capture of images and reconstruction of depth maps.

Deepak Kumar Saini  http://mrdg.iisc.ernet.in/dsaini/

**Title:** Studying impact of aging host on infection with intracellular pathogens using Salmonella as a model system.

The project will involve characterization of changes in Salmonella pathogenicity with respect to the age of the host and in conditions of exposure to certain drugs.

G K Ananthasuresh  http://www.mecheng.iisc.ernet.in/~suresh/

**Title:** Measuring forces applied by Cells in situ using Cell-stretching Devices.

This project entails culturing cells on in-house fabricated cell-stretching devices and performing mechanics-based calculations to estimate forces applied by the cells. Background in image processing and undergraduate mechanics is beneficial for this project but can be picked by bright students who are willing to learn something new.
Gopalkrishna Hegde

Title: Cell classification using plasmonics technique.

The project will involve synthesizing nanoparticles and properly integrating them with biosystems for plasmons generation. Nanoparticles embedded biological samples are imaged to see plasmon assisted fluorescence enhancement to visualize the motion of cells and thereby classifying the cells and cells separation. Both experimental and programming are expected for carrying out this research project.

Namrata Gundiah  http://www.mecheng.iisc.ernet.in/~namrata/

Title: Dynamics of collective cell migrations.

The motility of cells is essential in many physiological processes including the developmental patterning which guides embryogenesis, wound closure, immune response by white blood cells, and also in the uncontrolled movement of metastatic cells in most cancers. Whereas chemotactic stimuli are known to initiate and guide these responses, they alone are insufficient to explain the different rates of cell migrations, formation of tissues through morphogenesis, and the measured forces underlying these processes. The goals of this project are to image the migration of epithelial cells in monolayers, patterned in different shapes, and quantify the underlying dynamics. A custom fluid shear device will be used to explore the differences in migrations under shear. These data, in combination with immunofluorescence results, will be used to explore the individual roles of cell-cell and cell-substrate interactions in the collective dynamics of epithelial cells.


Title: Development and Evaluation of Online Cognitive and Hearing Test Software.

The project involves evaluation and updating an online cognitive and hearing test program with end users. The person will be responsible for data collection, analysis and upgrading existing system based on user feedback. Basic knowledge of html/javascript, statistics and good communication skill will be required. Our lab will provide training on basic data analysis techniques and access to cloud based data analysis software packages.

Prasanta Kumar Ghosh  http://www.ee.iisc.ac.in/people/faculty/prasantg/

Title: Comparison of digital auscultation devices for clinical quality assessment of swallow sounds in individuals with head and neck cancer.

Cervical auscultation is a method of listening to the swallowing sounds to assess the pharyngeal phase competence and its interaction with breathing typically using stethoscope. Use of digital stethoscope allows the digitization of the signal, a resource that enables the analysis of the sounds in a more objective way, considering their duration, signal frequency and the wave amplitude, among other aspects. There are a number of digital stethoscopes with wide variety of price ranges available that
records auscultation with varying quality. In this project, we would like to compare digital stethoscopes from three price ranges (low-cost, medium-priced, expensive) to assess the quality of swallow sounds using quantitative spatio-temporal analysis for individuals with head and neck cancer. This project is a preamble to developing a low-cost diagnostic and monitoring device for swallow sound assessment.

Rachit Agarwal  http://www.be.iisc.ernet.in/~rachit/

**Topic:** Development of metal particles for gene delivery to lungs. Inhalation route is one of the most patient compliant route that also eliminates the need for a trained personnel to administer the drug formulation. This is especially advantageous in developing countries where the access to the hospitals is not easy. In this project, we will develop high density metal particles in the size range of 300-800nm for delivery of gene to lungs via inhalation route. DNA plasmids carrying gene of interest will be loaded and evaluated for their ability to transfect mammalian cells.

Rahul Roy  http://nanobiology.nanobiophotonics.org/home/members/rahul-roy

**Title:** Probing cellular heterogeneity in bacterial gene expression.

Genetically identical bacteria can display large differences in gene expression of several genes resulting in different responses to drugs. In this project, a high resolution fluorescence microscopy technique called single molecule RNA fluorescence in situ hybridization (smFISH) will be employed to measure the copies of genes in single bacteria. The fellow will design the experiment, prepare the reagents and cells for imaging, conduct smFISH microscopy and analyze the data.

https://sites.google.com/site/singlemoleculernafish/

Sandhya Visweswariah  http://www.mrdg.iisc.ernet.in/sandhya/index.htm

**Title:** Monitoring changes in in intracellular signaling molecules using fluorescence resonance energy transfer.

We will utilize cell lines that express proteins that can detect the presence of cAMP and cGMP. These proteins change their conformation on binding these cyclic nucleotides and such changes can be detected by suitable fluorescent proteins associated with the cyclic nucleotide-binding protein. We will utilize high content imaging, machine learning and fluorescence activated cell sorting to monitor changes in cAMP and cGMP under various stimuli.

Saurabh Chandorkar  http://www.cense.iisc.ac.in/saurabh-chandorkar

**Title:** Cochlea in human ear using MEMS device.

Cochlea in human ear performs Fast Fourier Transform (FFT) of incoming sound waves. Individual hair on cochlea respond to different input frequency of sound which fires a neuron and eventually passes on the signal to the auditory center of the brain via auditory nerve. In the proposed project, the student will
explore the possibility of mimicking similar behavior using MEMS devices in conjunction with neural networks to discern patterns in not just sound but in any set of signals that can be transduced by sensors.

**Sheshagiri Gaonkar**

**Title:** Biomedical research to animal trials

1. Overview of animal models in research - Theory. 2. Handling, dosing and Sampling – demo as part of ongoing studies. 3. Sampling animal tissues, culturing and identification for bacteriology - hands on training

**Requirement:** Student should have theoretical exposure to biotech and microbiological techniques

**Siddharth Jhunjhunwala**  [http://www.be.iisc.ernet.in/~siddharth/](http://www.be.iisc.ernet.in/~siddharth/)

**Title:** Micro-particle surface modification for altering immune cell mediated phagocytosis.

As part of the BEST program, the student who joins my laboratory will obtain hands-on experience in the following: 1. In vitro cell culture of macrophage cell lines 2. Designing experiments to study sequential phagocytic uptake of polymeric particles. 3. Surface modification techniques 4. Working with antibodies to modify surface of particles and using them for immuno-staining


**Tejas Murthy**  [http://civil.iisc.ernet.in/~tejas/](http://civil.iisc.ernet.in/~tejas/)

**Title:** Understanding Mechanical Properties of Trabecular Bone using Discrete Element Method Simulations.

Contact Dynamics / Discrete Element simulations provide an excellent platform for building structures of heterogeneous porous solids such as bone. This short summer project will entail recreating the structure of a trabecular bone using a series of discrete particles. The distribution of pores, the inherent fabric and structure can be created using a series of spherical particles in contact. Further, a uniaxial compression test will be conducted on these simulated structures and the mechanical properties will be compared to the results of experiments conducted on trabecular bones. **Prerequisite:** Some knowledge of MATLAB or C programming.

**Vaishnavi Ananthanarayanan**  [http://www.be.iisc.ernet.in/~vaish/index.html](http://www.be.iisc.ernet.in/~vaish/index.html)

**Title:** Role of mitochondria in mediating symmetric cell division.

The objective of this short study is to understand if and how mitochondria regulate microtubule dynamics, and thereby control the positioning of the cell division plane in fission yeast. This work will
entail using a combination of live-cell imaging, image processing and analysis to quantitatively dissect the underlying mechanisms.