**Project Title:** Agile sensing and imaging platform for bio-marker discovery

**Project Number:** IMURA0958

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**Research Clusters:**

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<thead>
<tr>
<th>Cluster</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Material Science/Engineering (including Nano, Metallurgy)</td>
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<tr>
<td>2</td>
<td>Energy, Green Chem, Chemistry, Catalysis, Reaction Eng</td>
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<tr>
<td>3</td>
<td>Math, CFD, Modelling, Manufacturing</td>
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<tr>
<td>4</td>
<td>CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control</td>
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<td>5</td>
<td>Earth Sciences and Civil Engineering (Geo, Water, Climate)</td>
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<td>6</td>
<td>Bio, Stem Cells, Bio Chem, Pharma, Food</td>
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<td>7</td>
<td>Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng</td>
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<tr>
<td>8</td>
<td>HSS, Design, Management</td>
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**Research Themes:**

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<tr>
<td>1</td>
<td>Advanced computational engineering, simulation and manufacture</td>
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<tr>
<td>2</td>
<td>Infrastructure Engineering</td>
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<td>3</td>
<td>Clean Energy</td>
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<td>5</td>
<td>Nanotechnology</td>
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<td>6</td>
<td>Biotechnology and Stem Cell Research</td>
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<tr>
<td>7</td>
<td>Humanities and social sciences</td>
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<td>8</td>
<td>Design</td>
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The research problem
The objective is to develop compact, robust, and cost-effective sensing/imaging platform(s) for proteomics and metabolomics applications. The focus area is biomarker discovery for metabolic disease such as diabetes. Diabetes severely impacts upon vision, brain, and kidney, and is also associated with increased risk of viral infections. Specifically, coronavirus strains can alter body glucose metabolism leading to onset of diabetes, and may cause complications in patients with pre-existing diabetic conditions. The primary goal is to design rapid sensing/imaging platforms based on functionalized graphene derivative nano-composites to detect pH, color change and other dynamic attributes exhibited during a specific metabolite-enzyme reaction. The specific challenge lies in enhancing the effectiveness of the biomarker discovery process through use of AI/ML driven algorithms for rapid pattern retrieval and recognition.

Project aims
The principal aims of the project are:
1. Development of functionalized graphene derivative nano-composites.
2. Bio-sensing and imaging tool-box for monitoring metabolite-enzyme reaction attributes.
3. AI/ML driven algorithms for rapid and effective assessment.

What is expected of the student when at IITB and at Monash?
This interdisciplinary project will require and benefit from regular combined supervision at all times. In fact, most of the required facilities are available both at IITB and Monash. However, some specific arrangement is described below:
- Both at Monash and IITBombay: Nano-composite characterisation
- IITBombay: Bio-sensor design tools, Bio-imaging set-up for benchmarking purpose

Expected outcomes
1. Development of sensors for monitoring biomarker attributes
2. Development of algorithms for rapid bio-marker imaging

How will the project address the Goals of the above Themes?
The sensing and imaging capability will address the universal health-care objective related to early discovery of diabetes and related disease/disorders

Potential RPC members from IITB and Monash
IITB: Prof. Virendra Singh (EE), Prof Sanjeeva Srivastava (BSBE)
Monash: Dr. Parama Banerjee

Capabilities and Degrees Required
List the ideal set of capabilities:
Nanomaterials
| Sensors | Spectroscopy |

**Necessary Courses**
- Bio Sensors and Bio MEMS
- Nano-electronics
- Nano-electronic materials characterisation

**Potential Collaborators**
- Biotechnology companies focused on biomarker discovery, bio-sensing and bio-imaging

Select up to (4) keywords from the Academy’s approved keyword list ([available at http://www.iitbmonash.org/becoming-a-research-supervisor/](http://www.iitbmonash.org/becoming-a-research-supervisor/)) relating to this project to make it easier for the students to apply.

- Functional materials, Nanotechnology, Bioscience, Sensors