IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Development and Applications of Steady State and Frequency Domain Diffuse Optical Tomography Technique for Deep Tissue Imaging**	
Project Number	**IMURA0423**	
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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(*Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

Define the problem

The present proposal is concerned with the development and applications of steady and frequency-domain diffuse optical tomography imaging systems with an aim of using NIR excitable fluorescent markers to improve the specificity and contrast of the images. The scope of the

proposal also includes the in-house development of efficient tomography algorithms for reconstruction of the optical properties of turbid medium using the experimental data recorded using the developed imaging systems. Successful completion of the objectives proposed in the present work would act as a foundation for future applications of the developed DOT system at clinical level wherein the daily monitoring on bed-side while diagnosing the cancer tumors would be possible with the system, as it is non-ionizing and non-invasive.

Project aims

Define the aims of the project

Specific aims of the project include development of steady state and frequency-domain diffuse optical tomography set ups capable of imaging inhomogeneities embedded in biological samples. Along with the instrumentation development, efficient and robust reconstruction algorithms for the inversion of experimental data would also be developed.

Expected outcomes

Highlight the expected outcomes of the project

Expected outcomes of the proposed study are summarized as follows:

1. Steady state and frequency-domain diffuse optical tomography set ups capable of imaging inhomogeneities embedded in tissue simulating phantoms and biological samples.
2. Use of NIR excitable fluorescent markers to improve the specificity and contrast of the images.
3. Efficient and robust reconstruction algorithms for the inversion of experimental data to retrieve optical parameters of the sample.
4. Successful completion of the proposed objectives would act as a foundation for future application of the developed DOT system at clinical level wherein the bed-side monitoring of hemodynamics in tissues on day-to-day basis and diagnosis of tumors would be possible with the system, as it is non-ionizing and non-invasive.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The proposed project is important in the context of Bioengineering and Biotechnology as diffuse optical tomography is one of the newer optical imaging techniques which is non-ionizing in nature and is capable of deep tissue imaging. Unlike other relatively well-established techniques e.g. OCT wherein the depth of penetration is limited to few millimetres only, DOT is capable of providing diagnostics solutions for thicker biological samples and hence successful accomplishment of the objectives proposed in the work would lead to its applications at clinical level.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

The interested candidates should have knowledge/skills in two or more of the following domains:

1. Instrumentation development.
2. Algorithm and code development.
3. Understanding of light-tissue (turbid medium) interaction.
4. Desirable background: Mechanical, Electrical/Electronics, Physics, Biotechnology , Bioengineering, Chemical, Materials Engineering

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Potential collaborators have already been identified:
Prof. Sunita Chauhan, Monash University
Prof. Atul Srivastava, IIT Bombay.
Prof. Suneet Singh, IIT Bombay

Please provide a few key words relating to this project to make it easier for the students to apply.

Diffuse optical tomography, Light propagation in turbid medium, Diffusion equation, Reconstruction algorithms, Deep tissue imaging.