

# Introduction to Image based modeling and simulation: Applications in Musculoskeletal Biomechanics

## Overview

An introductory course that covers the fundamental understanding of medical imaging and its relevance in the development of musculoskeletal modeling for the applications in the area of orthopedic biomechanics and rehabilitation. The course has two parts – First is Introduction to image analysis based musculoskeletal model building. Second is its applications in understanding musculoskeletal disorders for upper and lower limb joints. The need for such a dedicated short program in biomedical computing was identified by many research funding agencies including the Biomedical Information Science and Technology Initiative at the NIH (The National Institutes of Health, Bethesda, USA), which stated an "extraordinary demand for people with good education in both biomedicine and computing" but "only a few cross-disciplinary training programs exist". In an attempt to bridge this gap, faculty at MNNIT Applied Mechanics department and faculty at IMT Atlantique, Brest and LaTIM INSERM U1101 have created this course. This course will be beneficial for biomedical engineers, clinicians, doctors and researchers in the field of orthopedic biomechanics.

The primary objectives of the course are as follows:

- i) Exposing participants to the fundamentals of musculoskeletal modeling using open source tools,
- ii) Build on the existing knowledge of the participants in image analysis, mathematics and physics to create field specific expertise in biomechanical problems that arise in current biomedical research and clinical practice,
- iii) With a basic introduction in musculoskeletal modeling, provide participants with training in the image analysis, and computational tools necessary to carry out end-to-end, subject specific simulations in orthopedic biomechanics.

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| <b>Modules</b>           | <ol style="list-style-type: none"> <li>1. Introduction to medical image processing, image registration, image segmentation</li> <li>2. Introduction to human musculoskeletal system</li> <li>3. Current practices in quantification of human joint biomechanics</li> <li>4. Modeling and Simulation of ventricular assist devices</li> <li>5. Multibody modeling of musculoskeletal system</li> <li>6. Introduction to OpenSim – an open source tool for musculoskeletal modeling</li> <li>7. Bone and muscle modeling</li> <li>8. Musculoskeletal disorders of upper limbs and their prevalence in India</li> <li>9. Model development and evaluation, data collection and management methods for validation</li> <li>10. OpenSim modeling of bones and muscles</li> <li>11. OpenSim musculoskeletal disorder models</li> <li>12. OpenSim forward and inverse dynamic modeling</li> <li>13. Advance techniques in OpenSim</li> <li>14. Advance problem building and solving in OpenSim</li> </ol> <p><b>Dates: April 22-26, 2019</b><br/> <b>Number of participants for the course will be limited to 40</b></p> |
| <b>Who should attend</b> | <ul style="list-style-type: none"> <li>• Engineers and researchers from healthcare, manufacturing, service and government organizations including R&amp;D laboratories.</li> <li>• Student at all levels (B.Tech./M.Sc./M.Tech./Ph.D.) or Faculty from reputed academic and technical institutions.</li> </ul>  |
| <b>Fees</b>              | <p>The participation fees for taking the course is as follows:</p> <p><b>Participants from abroad : US\$300</b><br/> <b>Industry/ Research Organizations: INR 5,000.00</b><br/> <b>Faculty from Academic Institutions: INR 1,000.00</b><br/> <b>Students: INR 100.00</b></p> <p>The above fees include all instructional materials, computer usage for tutorials and assignments, and free internet facility. The participants will be provided with boarding and lodging in campus on payment basis subject to availability.</p> <p>All course registrations will processed via the national GIAN portal (<a href="http://gian.iitgp.ac.in">gian.iitgp.ac.in</a>), where a Rs. 500/- one-time fee is payable in addition to the above amount.</p> <p>Registration fee details will be notified soon.</p> <p><b>Last Date of Registration: 10 April, 2019</b></p>   |

# The Foreign Faculty



**Dr. Bhushan Borotikar** is a Senior Research Scientist at a Research lab (LaTIM) of French Medical Institutes of Health (INSERM U1101). Dr Borotikar finished his Master of Science degree in Biomedical Engineering from the University of Texas at Arlington, Texas, USA in 2003, his PhD in Applied Biomedical Engineering from the Cleveland State University, Ohio, USA and Cleveland Clinic, Ohio, USA in 2009. He then was selected as a post-doctoral fellow in the National Institutes of Health, Bethesda, USA till 2014. Since 2014, he is working as a senior research scientist in France. Dr Borotikar has published extensively in peer-reviewed journals and international conferences. He also has written book chapter(s) in a computer guided

surgery and medical image analysis book. Dr Borotikar is an expert in multibody musculoskeletal modelling using OpenSIM and is involved in projects for both upper and lower limb modelling: like OpenKnee (<https://simtk.org/projects/openknee>) and French paediatric shoulder model (<https://simtk.org/projects/fpsm>). Dr Borotikar has extensive collaborations worldwide for his research work. He has been involved in international research teams to do collaborative projects with multiple researchers in multiple countries. He is currently awarded an honorary Senior Lecturer position at the University of Cape Town, South Africa in their Division of Biomedical Engineering. Most of his research interests are focused on developing clinical and engineering tools in three areas: 1) Musculoskeletal disorders in adults and children, 2) Computer assisted surgeries, and 3) Medical device designs.



**Dr. R.P. Tewari** is Professor in the Department of Applied Mechanics at Motilal Nehru National Institute of Technology, Allahabad, India. He is a life member of ISTE, New Delhi and Biomedical Society of India. His research interests include Biomechanics, Biomaterials, Bio-instrumentation and Rehabilitation Engineering.



**Dr. Basant Kumar** is Associate Professor in the Department of Electronics and Communication Engineering at Motilal Nehru National Institute of Technology, Allahabad, India. His area of research includes medical image processing, medical instrumentation, telemedicine, medical image compression, digital watermarking and data hiding. He has published more than 35 research papers in reputed international journals/conferences. He has more than 15 years of teaching and research experience. Currently, he is reviewer and guest editor of many international journals.

## Course Coordinator

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