Integration of Biomechanics, Control and Neurophysiology

Overview

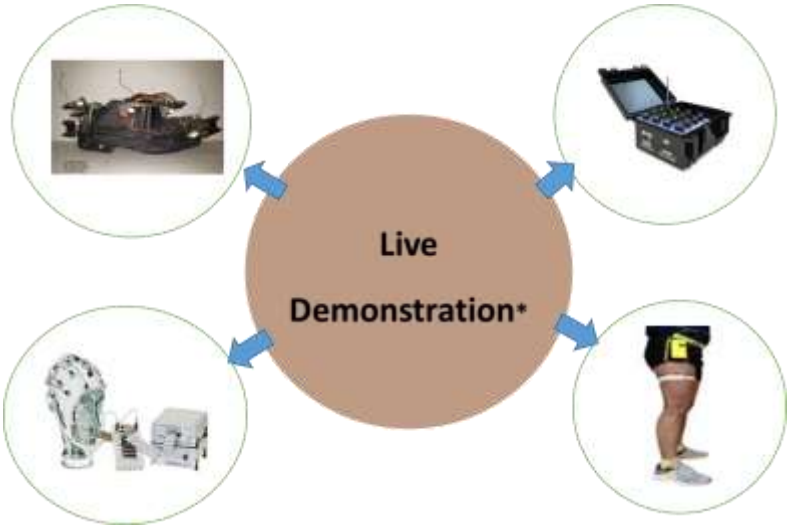
The fine understanding of the biomechanics of human movement is important in neurorehabilitation, development of intelligent prosthesis, clinical and sport biomechanics.

This course will introduce students to the application of classical biomechanics to understand the theory of biomechanics in human movement (includes both kinematics and kinetics). This knowledge will be then strengthen via introducing some case studies and tutorials related to sports applications. The students understanding of these concepts will be examined through the study of normal gait dynamics, application of electromyography; motion and force/pressure measuring equipment and techniques; inverse dynamics modelling of the human body; current topics in Neurophysiology application of Biomechanics. Specifically to make students aware of current state of the art in this research will promote the analytical skills of the students in understanding of the research aspects of the present course.

Objectives

The primary objectives of the course are as follows:

1. Practical/Clinical Application of Joint Kinetics/ Kinematics
2. Development of Force Sensors for Sport Applications
3. Biomechanics Applications for Adaptive Motor Learning and Device Control
4. Development of Interactive Gaming as Experimental/Design Protocol
5. Signal Processing challenges in Neuro-prosthetics : A Machine Learning approach for mapping of neural activity to locomotion
6. Describe the role of biomechanical analysis for intelligent prosthesis design and development.
7. Describe the biomechanical factors that affect Force/pressure analyses: A detailed study
8. Neurophysiology of Foot pressure variation in Diabetic neuropathy : An experimental approach
9. Develop a working knowledge of common modelling/simulation tool used in biomechanical analysis.



***HIGHLIGHTS**

- Demo (via **Skype, live streaming from IIT Delhi**) of wireless recording of **EEG/ EMG/ acceleration**.
- Case study discussions with **signal processing** of recorded data.

Tentative Schedule

Modules (Course content)	**Dates: October 3st – October 7th, 2019**	
	Day 1 **October 3, 2019 (Thursday)**	❖**Registration and Inauguration** ❖**Lecture 1:** Review of Joint Kinematics/Kinetics ❖**Lecture 2:** Practical/Clinical Application of Joint Kinetics -Forces / Moments ❖**Lecture 3:** Development of Force Sensors for Sport Applications ❖**Case study 1:** Within Shoe Pressure Measurements: Clinical Applications
	Day 2 **October 4, 2019 (Friday)**	❖**Lecture 4:** Biomechanics Applications in Sport: Injury Prevention and Performance Enhancement ❖**Lecture 5:** Biomechanics Applications for Adaptive Motor Learning and Device Control ❖**Lecture 6:** Integrative Applications between Biomechanics, Robotic Control and Neurophysiology, Part I: Control Theory vs. Biology ❖**Case Study** : Integrative Applications between Biomechanics, Robotic Control and Neurophysiology, Part II: Neurogame Therapy
	Day 3 **October 5, 2019 (Saturday)**	❖**Lecture 7:** Integrative Applications between Biomechanics, Robotic Control and Neurophysiology, Part III: Development of Interactive Gaming as Experimental/Design Protocol ❖**Lecture 8:** Journal Discussion I: Current state of art in Clinical Application of Biomechanics ❖**Tutorial 1 :** Journal Discussion I: Current state of art in Adaptive Robotic Control Application of Biomechanics ❖**Tutorial II :** Journal Discussion II: Current state of the art in Sport Application of Biomechanics

	Day 4 **October 6, 2019 (Sunday)**	❖**Lecture 9:** Instrumentation for Neuromechanics: Electroencephalogram(EEG), Electromyogram (EMG), Inertial Measurements, Centre for Pressure (CoP), Force Myography (FMG) ❖**Lecture 10:** Demonstration through Skype for EEG and EMG Recording (Live streaming from Neuromechanics Lab, IIT Delhi ❖**Lecture 11:** Signal Processing with Case study on collected data
	Day 5 **October 7, 2019 (Monday)**	❖**Lecture 12:** Biomechanical factors affecting foot force/pressure: A detailed study ❖**Lecture 13 :** Neurophysiology of Foot pressure variation in Diabetic neuropathy : An experimental approach Biomechanical variables (joint angle & acceleration measurement) ❖**Lecture 14 :** An introduction to Modeling/simulation tool for biomechanical analysis ❖**Tutorial IV :** Finite Element modelling approaches in biomechanics: A demo
Who can attend?	➢B.Tech / M.Tech / PhD students of Mechanical, Biomedical Engineering, Instrumentation &Control Electrical, Electronics and Medical students (with special interest), who are likely to be benefited by learning the fundamental aspects of Biomechanics of human movement. ➢Faculty members, Research Associates, Clinicians and Industry partners from reputed academic / technical and Medical institutions. ➢Students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions. ➢Number of participants for the course will be limited to **fifty**	
Course fees	The participation fees for taking the course is as follows: • Participants from abroad : US $500 • Faculties from academic institutions/Govt. research organizations : 5000/- • Person from Industry : Rs. 10,000/- • Ph.D students : Rs. 3000/- • B.Tech./M.Tech./M.Sc./Medicine : Rs. 2000/-	

How to register	**Stage 1: GIAN Web (Portal) Registration:** (Individuals who have already registered to GIAN earlier do not need to repeat) Visit GIAN Website at the link: http://www.gian.iitkgp.ac.in/GREGN/index and create login user ID and Password. Fill up the registration form and do web registration by paying Rs.500/- through online Net Banking/ Debit/ Credit Card. Please do not confuse GIAN web registration with course registration. The course registration fee is separate. The candidate has to pay course registration fee as per stage 3 given below. Registration to the GIAN portal is one-time affair and will be valid for lifetime of GIAN. Once registered in the portal, an applicant will be able to apply for any number of GIAN courses as and when necessary. **Stage 2: Course Registration (Through GIAN Portal):** Log in to the GIAN portal with the user ID and Password created in Stage 1. Click on "Course Registration" option given at the top of the registration form. Select the Course titled " **Integration of Biomechanics, Control and Neurophysiology**" from the list and click on "Save" option. Confirm your registration by Clicking on "Confirm Course". **Last date for Registration: 29th Sept, 2019** **Stage 3: Course Fee Payment (Only selected candidates):** The Course Coordinator will intimate only Selected Candidates through E-mail. They have to remit the necessary course fee in the form of DD drawn in favor of "**The Director, NIT, Tiruchirappalli – 620015**" payable at NIT-Tiruchirappalli. **The DD along with the signed hard copy of the filled in application should be sent to the following address**: **Dr. R. Periyasamy** Assistant Professor Department of Instrumentation and Control Engineering National Institute of Technology Tiruchirappalli – 620 015 E-mail: periyasamyr@nitt.edu Phone No:9179826937 **For any queries, you may contact**: Ms. Sangeetha B Mobile : 9677477303 or mailto: sangeetha27may@gmail.com

The Teaching Faculty

Dr. Michael E Hahn is an Associate Professor in the Department of Human Physiology at University of Oregon, United States. He is also serving as the Director of the Bowerman Sports Science Clinic (BSSC) at University of Oregon. He received his PhD in Exercise and Movement Science from University of Oregon in 2003. He has been working in the area of biomechanics and motor control for around fourteen years. He has received research grant funding of more than 4 million USD for his various scientific projects. He has published more than 40 peer reviewed articles in journal of repute like IEEE transactions on biomedical engineering, IEEE journal of biomedical and health informatics, journal of biomechanics, and gait and posture. One of his work on lower limb prosthetics is under consideration for US patent award. He has supervised around 17 M.S/PhD students and 2 postdoctoral fellows till date. He is a member of American Society of Biomechanics (ASB) and American Society of Mechanical Engineers (ASME). Currently, he is exploring gait analysis towards the explicit understanding of motor behaviour and its application in sports science and engineering

Webpage: https://physiology.uoregon.edu/profile/mhahn/

Research gate: https://www.researchgate.net/profile/Michael_Hahn6

Dr. Deepak Joshi received his PhD in biomedical engineering from Indian Institute of Technology (IIT) Delhi. He has been working in the area of prosthetics design and development for last ten years. During his tenure at Department of electrical and computer Engineering in National University of Singapore (NUS), he worked on development of artificial hand with integrated sensors to create an illusion of touch from human hand. This work demonstrated a significant impact on the social acceptance of upper limb prosthesis and was reported to be the most popular article in IEEE Transaction on neural system and rehabilitation engineering. His research work at Institute of Neuroscience (ION), Newcastle University in United Kingdom (UK) discovered that artificial proprioception can significantly improve the myoelectric control in upper limb amputee. During his postdoctoral at University of Oregon in United States of America (USA), he worked on integration of various sensing modalities to provide seamless transitions in lower limb prosthesis. Dr. Joshi is currently exploring visual motor control for seamless transition in powered prosthesis and the role of artificial proprioception in lower limb prosthesis and gait rehabilitation. Besides that, he is actively engaged in projects related to development of biomedical instrumentation for applications specific to assistive devices for elderly and disabled.

Webpage: http://cbme.iitd.ac.in/content/dr-deepak-joshi

Dr.R Periyasamy received his Ph.D in Biomedical Engineering from IIT Delhi, New Delhi. He has been working in the area of multimodal foot biomechanical assessment in diabetic and aging subject for last five years. During the research period, he has published about 15 International journal publications and about 5 International Conference proceedings. Most importantly, his research work has been published in reputed journals like Journal of Engg in medicine, Journal of

Principal Coordinator

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Medical Engg and Technology, Journal of Medical imaging and health informatics and International journal of diabetes in developing countries. He got best research poster award from technical committee of IEEE conference at IIT Kharagpur, India and received travel grants from CSIR India to present his research work in abroad. In addition, recently he got Young faculty award 2015 from Venus international foundation, Chennai. Earlier he worked as an Assistant Professor at NIT Raipur in the Department of Biomedical Engg, from July 2013 to May 2018. Recently he joined as an Assistant Professor in the Department of Instrumentation & Control Engineering, NIT Trichy from May 2018 onwards. Currently his research interest includes Biomedical Instrumentation, Sensors & Transducer, Gait Analysis, Biosignal and Image processing, Diagnostic device development, Near Infrared Spectroscopy etc .Further, he has ongoing three DST funded research project from SERB & IDP division and 10 international publications in the high impact factor journals.

Webpage:
https://www.nitt.edu/home/academics/departments/ice/faculty/asstprof/periyasamyr/

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