Models of Walking & Running: Human Gait & Robot Locomotion

Overview

Humans and other bipeds walk efficiently through the cyclic exchange of potential and kinetic energy and run efficiently via the cyclic storage and return of elastic energy. Understanding these mechanisms of energy exchange can aid in the diagnosis and treatment of human gait pathologies, but they can also inform the design and control of legged robots capable of efficient, dynamic locomotion. Relatively simple models capture the dominant dynamics of both walking and running gaits, so they can serve as templates whose fundamental motions are embedded in the gait planning and control of complex biped robots.

This course is aimed at senior undergraduate and graduate students who wish to broaden their knowledge of biped locomotion as it applies to both human biomechanics and legged robots. The course will introduce the inverted pendulum model of walking, the spring-loaded inverted pendulum (SLIP) model of running, and the dual-SLIP model that enables seamless transition between the two gaits. Students will gain in-depth knowledge and understanding of how these models capture the critical characteristics of human locomotion and how they can inform the design and control of robot gaits. On completing this course, students will be able to:

- describe the primary mechanisms of energy savings in human walking and running gaits;
- formulate template models that capture key aspects (kinematic, dynamic, energetic, etc.) of human walking and running gaits;
- identify the advantages and limitations of template models of human locomotion; and
- apply template models of locomotion to improve dynamic legged robot control.

Dates for the course	22nd to 27th July 2019
Host Institute	IIT Madras
No. of Credits	1
Maximum no. of participants	30
This course is suitable for…	Students and professionals working in the areas of biomechanics, robotics, and medicine (especially orthopaedics, prosthetics and rehabilitation)
Course Registration Fees	Student participants from IIT Madras or other approved institutes of GIAN - Rs. 1000 per credit; Non-student participants - Rs. 3000 per credit. These fees apply toward participation in the course, obtaining course material, computer use for tutorials and assignments, and laboratory equipment usage. Accommodation is not a part of the registration fee. Mode of payment: Online transfer: (Preferred) Account Name: CCE IIT Madras Account No: 36401111110 Branch: SBI, IIT Madras Branch, Chennai IFSC Code: SBIN0001055 **OR** Demand draft in favour of "CCE, IIT Madras" payable at Chennai. The demand draft is to be sent to the Course Coordinator at the address given below.
Accommodation	Accommodation: The participants may be provided with hostel accommodation, depending on the availability, on payment basis. Accommodation is not a part of registration fee. Request for hostel accommodation may be submitted through the link: http://hosteldine.iitm.ac.in/iitmhostel

Course Faculty

Professor James P. Schmiedeler

Professor Jim Schmiedeler is the Associate Chair of the Department of Aerospace and Mechanical Engineering at the University of Notre Dame. He received a PhD in mechanical engineering from The Ohio State University, Columbus USA. Prior to joining the University of Notre Dame, he held tenure-track faculty positions at the University of Iowa and The Ohio State University. He is a Fellow of the American Society of Mechanical Engineers and a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE). His research in legged robots and human biomechanics has been supported by the National Science Foundation and the National Institutes of Health.

Professor Sujatha Srinivasan

Professor Sujatha Srinivasan heads the TTK Center for Rehabilitation Research and Device Development (R2D2) in the Department of Mechanical Engineering at IIT Madras. She received a PhD in Mechanical Engineering from the Ohio State University, Columbus, USA. She worked in the prosthetics industry for about 8 years prior to starting her PhD. She has been at IIT Madras since 2008 and her research focuses on biomechanics and mechanisms geared towards the development of assistive devices for people with locomotor disability. More details are available at https://home.iitm.ac.in/r2d2.

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For detailed syllabus, please visit:
https://home.iitm.ac.in/r2d2/gian_walkingmodels