The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

Andres Kecskemethy

Chair for Mechanics and Robotics
University of Duisburg-Essen, Germany

Lecture Title: Integrating Efficient Kinematics in Biomechanics of Human Motion

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Abstract

Biomechanical modeling of human motion often is based on simple tree-type structures with elementary joint and contact situations. This is adequate for coarse evaluation of motion parameters and their effects but insufficient for detailed analysis of joint or system/environment interactions. In this lecture, an object-oriented approach for the modeling of kinematics and dynamics of musculoskeletal motion is presented which is open for integration of arbitrarily complex subsystems and their coupling to state-of-the art numerical and visualization tools. The approach is based on the concept of kinetostatic transmission element which allows one to embed intricate kinematical dependencies in easy-to-use, multilayered objects. Based on this approach, the inverse and direct dynamics problem can be formulated in a highly-efficient and implementation-independent manner, featuring different methodologies as 'flavors' of the generic transmission properties. This allows one to re-use methods developed for technical systems such as contact effects, multiloop transmission mechanisms, multidisciplinary mechatronic components, and efficient numerical solution schemes. The concepts are illustrated by the object-oriented 3D biomechanical simulation environment MobileBody featuring mechanism surrogates for joint motion, higher-order foot-ground contact, data fusion of MRI and motion capturing, composite numerical clinical scoring algorithms, optimization-based muscle activation identification, verification by interval analysis, and embedded 3D visualization.

Biography

Professor Kecskeméthy graduated from the University of Stuttgart in Mechanical Engineering in 1984 and received his Ph.D. in Mechanical Engineering from the University of Duisburg in 1993. From 1994 to 1995, he stayed as a senior guest researcher at the Centre for Intelligent Machines at McGill University with a fellowship from the German Research Foundation (DFG). In 1996, Dr. Kecskemethy was appointed Professor at the Technical University of Graz, where he held the Chair for Mechanics until 2002. In 2002, Professor Kecskeméthy moved to the University of Duisburg-Essen, where he holds the Chair for Mechanics and Robotics at the Institute of Mechatronics and System Dynamics. He is currently Editor-In-Chief of the Journal Mechanism and Machine Theory. He served as Dean of the Faculty of Engineering of and as Chairman of the Senate of the University Duisburg-Essen. His memberships include the German Engineering Association VDI and the International Federation for the Promotion of Mechanism and Machine Science. Professor Kecskeméthy has worked in the areas of kinematics and dynamics of multibody systems,covering topics such as modelling and control of mechatronic systems, vehicle dynamics, design of legged machines, biomechanics, virtual reality and heavy-weight robotics. He is author of more than 140 proceedings and journal papers.

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