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USP Universidade de São Paulo

Motion Control of Complex Robotic Systems:

Challenges, Design, and Experiments

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Abstract of the talk

Robotics was initially and for a long time guided by needs in industry. Indeed, the early years of robotics was largely focused on robot manipulators, used mainly for simple and repetitive tasks for automation. The first industrial robot manipulator appeared in 1961 in the assembly lines of General Motors. The link between Automatic control and robotics is strong. Indeed, control theory has enabled solutions to fundamental problems in robotics, and problems in robotics have motivated the development of new control schemes. The early robot control systems were designed to control independently each axis of the robot as a Single-Input-Single-Output (SISO) linear system. Linear automatic control theory was then extensively used in this basic solution, where the coupling dynamics between the different axes of the robot were often neglected and the robot model was significantly simplified. Beyond these issues, the main barriers to progress were the high cost of computation, the lack of good sensors, and the lack of fundamental understanding of robot dynamics. However, the progress of robotics and automation as well as their associated innovative applications has required the consideration of more and more complex tasks needing high performances. These challenging tasks required a deeply understanding of complex nonlinear dynamics of robots. Besides, it has also motivated the development of new theoretical advances in different control fields (nonlinear, robust, adaptive, etc.), which has consequently enabled more sophisticated applications. Nowadays, robotic control systems are highly advanced, including manipulation robotics, underwater robotics, aerial robotics, mobile robotics, medical robotics, parallel robotics, wearable robotics, humanoid robotics and more others.

This lecture will be mainly focused on control of complex robotic systems, where their associated challenges will be first emphasized and illustrated through different applications in robotics. Then, for each of these fields, the motivations and the need of developing of advanced control schemes will be highlighted. Finally, some proposed control solutions are introduced along with their real-time experimental validations.

Short Biography: Ahmed Chemori received his M.Sc. and Ph.D. degrees, both in automatic control from Polytechnic Institute of Grenoble, France, in 2001 and 2005 respectively. During the year 2004/2005 he was a Research and Teaching assistant at Laboratoire de Signaux et Systèmes (LSS - Centrale Supelec) and University Paris 11. Then he joined Gipsa-Lab (Former LAG) as a CNRS postdoctoral researcher. He is currently a senior research scientist in Automatic control and Robotics for the French National Center for Scientific Research (CNRS), at LIRMM research laboratory. His research interests include nonlinear (robust, adaptive, and predictive) control and their real-time applications in robotics (underactuated, parallel, underwater, humanoid and wearable robots). He is the author of more than 150 scientific publications, including international journals, patents, books, book chapters and international conferences.

https://www.researchgate.net/profile/Ahmed-Chemori

https://scholar.google.fr/citations?user=EQP56YEAAAAJ&hl=en

https://www.youtube.com/AhmedCHEMORI_RobotControl