

UNIVERSITY OF MACAU
FACULTY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

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**Bilateral Teleoperation for Robots with Time Delay and
Varying Dynamics**

by

Prof. Rodney G. ROBERTS

*Fulbright Scholar
University of Macau*

Professor

Department of Electrical and Computer Engineering, Florida State University

Date : **4 March 2016 (Friday)**
Time : **11:00 – 12:00**
Venue : **E11-1009**

ABSTRACT

Teleoperation involves the use of robots at a distance and is particularly useful for tasks requiring robots to operate in dangerous and inhospitable environments. Bilateral teleoperation provides the operator with force feedback via a master device used to control the remote robot during teleoperation. The force feedback enhances teleoperation for the operator by providing the operator with the ability to feel interactive forces rather than just visual and/or auditory cues. Unfortunately, time delay across the communication link between the local device and remote robot can cause instability in the system. The wave variable method is a common approach for guaranteeing stability for bilateral teleoperated systems with time delay. Although this method guarantees stability for the constant time delay case, performance is still degraded due to transient oscillations known as wave reflections. This becomes more prominent when there exist a mismatched impedance. In this research, we introduce wave filters to address the issue of wave reflections for teleoperation systems with varying slave dynamics.

BIOGRAPHY

Rodney G. Roberts received B.S. degrees in Electrical Engineering and Mathematics from Rose-Hulman Institute of Technology, Terre Haute, IN, in 1987 and the M.S.E.E. and Ph.D. degrees in Electrical Engineering from Purdue University, West Lafayette, IN, in 1988 and 1992, respectively. From 1992 to 1994, he was a National Research Council Fellow at Wright-Patterson Air Force Base (AFB), Dayton, OH. Since 1994, he has been at Florida State University, where he is a Full Professor in the Department of Electrical and Computer Engineering. Currently, Prof. Roberts is a Fulbright Scholar at the University of Macau. His research interests include robotics, parallel mechanisms, and teleoperation. Prof. Roberts is active in the IEEE Systems, Man, and Cybernetics Society and serves as the SMCS Vice

President for Systems Science and Engineering and as an Associate Editor for the IEEE Transactions on Systems, Man, and Cybernetics: Systems.

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Trend of the Smart Grid Development

by

Prof. Wei Jun LEE

*Professor and Director Energy Systems Research Center,
The University of Texas at Arlington, Texas, USA*

Date : 18 June 2015 (Thursday)
Time : 10:15 – 10:45
Venue : Library Auditorium, Wu Yee Sun Library

ABSTRACT

The electrical power system in the US has been named as "the supreme engineering achievement of the 20th century" by the National Academy of Sciences. While the power system is a technological marvel, it is also reaching the limit of its ability to meet the nation's electricity needs. In addition, our nation is moving into the digital information age that demands higher reliability from the nation's aging electrical delivery system.

The modernization of the electricity infrastructure leads to the concept of "smart grid". A comprehensive smart grid design should cover both top-down and bottom-up approaches. For the current centralized generation and transmission system, upgrading the power delivery infrastructure, enforcing the system security requirement, and increasing interoperability are well known techniques to improve the reliability and the controllability of the power system. For the bottom-up approach, one of the most important features is its ability to support a more diverse and complex network of energy technologies. Specifically, it will be able to seamlessly integrate an array of locally installed, distributed power sources with smaller CO2 footprint, such as fuel cells, photovoltaic, and wind generation, into the power system.

This presentation discusses the opportunities and challenges for the development of Smart Grid, highlights the smart grid related researches and developments. The presentation concludes with the listing of issues needed to be addressed to ensure successful integration procedures that will eventually create new structures of efficient, modular and environmentally responsive electricity infrastructure that will have an impact nationally as well as globally.



BIOGRAPHY

Wei-Jen Lee received the B.S. and M.S. degrees from National Taiwan University, Taipei, Taiwan, R.O.C., and the Ph.D. degree from the University of Texas, Arlington, in 1978, 1980, and 1985, respectively, all in Electrical Engineering.

In 1985, he joined the University of Texas at Arlington, where he is currently a professor of the Electrical Engineering Department and the director of the Energy Systems Research Center.

He has been involved in the revision of IEEE Std. 141, 339, 551, 739, and dot 3000 series development. He is the Chair of the IEEE/IAS, Industrial & Commercial Power Systems Department (ICPSD), associate editor of IEEE/IAS and guest editor of IEEE Transactions on Smart Grid. He is the project manager of IEEE/NFPA Collaborative Research Project on Arc Flash Phenomena.

Prof. Lee has been involved in research on utility deregulation, renewable energy, smart grid, microgrid, arc flash and electrical safety, load forecasting, power quality, distribution automation and demand side management, power systems analysis, online real time equipment diagnostic and prognostic system, and microcomputer based instrument for power systems monitoring, measurement, control, and protection. He has served as the primary investigator (PI) or Co-PI of over ninety funded research projects. He has published more than three hundred and twenty journal papers and conference proceedings. He has provided on-site training courses for power engineers in Panama, China, Taiwan, Korea, Saudi Arabia, Thailand, and Singapore. He has refereed numerous technical papers for IEEE, IET, and other professional organizations.

Prof. Lee is a Fellow of IEEE and registered Professional Engineer in the State of Texas.

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