

TOK2013
WORKSHOP PROGRAMME
25 September 2013

A

Title: LINEAR AND NONLINEAR CONTROL SYSTEMS

Presenter: Professor Derek P. Atherton

25 September 2013 Morning 09:00-12:30

Course Outline (09:00-12:30):

1. PID Controller Tuning
2. Nonlinear Control(Introduction, The Phase Plane, The Describing Function, Stability and Limit Cycles Using DF)

Tea Break

3. Nonlinear Control(The SSDF and Harmonically Forced Systems, Limit Cycles in Relay Systems, Absolute Stability Results, Design of Nonlinear Control Systems)
4. Simulation and Nonlinear Systems

Lunch (12:30-13:45)

B

Title: FRACTIONAL ORDER MOTION CONTROLS: HOW MOTION CONTROL CAN BENEFIT FROM USING FRACTIONAL CALCULUS?

Presenter: Professor YangQuan Chen

25 September 2013 Afternoon 14:00-18:00

Course Outline (2+2 hours-14:00-18:00):

Part 1: Fundamentals of Fractional Order Controls

Session 1A: Overview and Introduction

Part 2: Fractional Order Velocity Controls

Session 2A: Fractional Order PI Controller Designs for Velocity Systems

Session 2B: Tuning Fractional Order PI-Controllers

Part 3: Fractional Order Position Controls

Session 3A: Fractional Order PD Controller Designs for Position Systems

Session 3B: Tuning Fractional Order PD Controllers

Part 4: Stability and Feasibility

Session 4A: Stability and Design Feasibility of Robust PID Controllers for FOPTD systems

Session 4B: Stability and Design Feasibility of Robust FOPI Controllers for FOPTD system

Tea Break

Part 5: Fractional Order Disturbance Compensations

Session 5A: Fractional Order Disturbance Observer

Session 5B: Fractional Order Adaptive Compensation

Adaptive Feed-Forward Cancellation/Adaptive Compensation for Cogging Effect/Adaptive Learning Compensation

Part 6: Effects of Fractional Order Controls on Nonlinearities

Session 6A: Fractional Order PID Control of a DC-Motor with Elastic Shaft

Session 6B: Fractional Order Ultra Low-Speed Control

Part 7: Fractional Order Motion Control Applications

Session 7A: Lateral Fractional Order Control of a small UAV

Session 7B: Fractional Order PD Controller Synthesis and Implementation on an HDD

Part 8: Recent results in fractional order modeling and control of renewable energy systems
(time permits)

**Professor Derek P. Atherton,
University of Sussex, Brighton, UK**



Derek Atherton studied at the universities of Sheffield, where he obtained a first class BEng in 1956, and Manchester where he obtained a PhD in 1962 and DSc in 1975. Whilst at Manchester he was also employed as an assistant lecturer and then lecturer, and gave his first control course, known as servomechanisms, in 1958. He spent the period from 1962 to 1980 teaching in Canada first at McMaster University and then at the University of New Brunswick. He served on several National Research Council Committees, including the Electrical Engineering Grants Committee and the NMO for IFAC, which he also chaired.

He took up the post of Professor of Control Engineering at the University of Sussex in 1980 and is currently retired but has an office at the university and the title of Emeritus Professor. He has been active with many Professional engineering bodies, serving as President of the Institute of Measurement and Control in 1990 and as President of the IEEE Control Systems Society in 1995, being the first non North American to hold the position. He was a member and also chaired the UK NMO for IFAC and was a member of the IFAC Council from 1990-96. He was an Editor of the IEE

Proceedings on Control Theory and Applications (CTA) for several years until 2007 and also an editor for the IEE Control Engineering Book Series. He served EPSRC on research panels and as an assessor for research grants for many years and also served as a member of Electrical Engineering Panel for the Research Assessment Exercise in 1992.

His major research interest have been in nonlinear control theory, computer aided control system design, simulation and target tracking. He has written two books, is a co-author of two others and has published more than 350 papers in Journal and Conference Proceedings. More recently he has written two electronic books one on linear control and the other on nonlinear control, which are freely downloadable from www.bookboon.com. He has just completed a book of examples and problems to support them. Professor Atherton has given invited lectures in many countries and supervised over 30 Doctoral students.

Professor YangQuan Chen **University of California, Merced, USA**



YangQuan Chen was a faculty member of ECE Dept. of Utah State University before he joined UC Merced in Fall 2012. He earned his Ph.D. from Nanyang Technological University, Singapore in 1998, MSc. from Beijing Institute of Technology in 1989 and BS. from University of Science and Technology of Beijing in 1985. His current areas of research interests include: distributed measurement and distributed control of distributed parameter systems using mobile actuator and sensor networks, smart mechatronics and process controls, applied fractional calculus in controls, signal processing and energy informatics, multi-UAV based personal cooperative remote sensing and real time water management and irrigation control.

Dr. Chen is an Associate Editor on the Conference Editorial Board of the Control Systems Society of the IEEE (since 2002), an Associate Editor on the International Society of Automation (ISA) Editorial Board for the American Control Conference (since 2004) and an Associate Editor on the Conference Editorial Board of the Robotics and Automation Society of the IEEE (since 2012). He served as the General Chair for IEEE/ASME Int. Conf. on Mechatronics and Embedded Systems Applications (MESA) 2010, Qingdao, China and the Program Chair for the ASME/IEEE Int. Conf. on MESA, Las Vegas, NV, 2007 and MESA09 San Diego, CA, 2009 and Program Co-Chair for the IEEE International Conference on Mechatronics and Automation for 2006 and 2007. He was the TC Chair for MESA under ASME DED, Chair for MES for IEEE ITSS, and is a member of IFAC TC2.2. He serves as an Associate Editor for

Acta Montanistica Slovaca, Fractional Calculus and Applied Analysis (FCAA), ASME J. of Dynamic Systems, Measurement and Control, International Journal of Advanced Robotic Systems, IFAC journal of Mechatronics, ISA Transactions, IEEE Transactions on Control Systems Technology (TCST), and IFAC journal Control Engineering Practice (CEP). Dr. Chen is a member of Editorial Advisory Board of An International Journal of Optimization and Control: Theories & Applications (IJOCTA). He won IFAC Journal of Control Engineering Practice Best Paper Award at 2011 IFAC World Congress. Since 2012, Dr. Chen serves as TC Co-Chair for IEEE RAS Technical Committee on Aerial Robotics and Unmanned Aerial Vehicles.

Dr. Chen is a senior member of IEEE, a member of ASME, AUVSI, AMA (Academy of Model Aeronautics), AWRA (American Water Resources Association) and ASEE (American Society of Engineering Educators).