

Center of Excellence in Intelligent Engineering Systems (CEIES) King Abdulaziz University

Workshop On

Challenging Problems in Systems Engineering



Venue

Engineering Building, Third floor, Room 34C13 (Next to ECE Council Meeting Room)

Tuesday December 29, 2015

Session I:

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Session II:

1:00 p.m.	King Salman ben Abdulaziz Chair for Energy Research						
	Dr. Abdulsalam Saeed Alghamdi						
1:15 p.m.	Solar Photovoltaic Systems and Applications in Buildings						
	Prof. Abubakr Salim Bahaj						
2:00 p.m.	Combined Management and Control for Optimal Energy						
	Efficiency of Buildings using Renewable Energy Sources						
	Prof. Maamar Bettayeb						

Wednesday December 30, 2015

Session III:

 10:00 a.m. Simultaneous Localization and Mapping (SLAM) for Mobile Robots: State of the Art Dr. Muhammad Shehzad Hanif
11:00 a.m. Architectural simplification of Histogram of Gradient based Pedestrian Detector for Implementation on Low Power FPGA Dr. Muhammad Bilal

Session IV:

Recent	Results	on	the	Identification	and	Control	of
Fractior	nal Order	Syst	ems,	Part 1			
Prof. Maa	amar Bettay	veb					
Recent	Results	on	the	Identification	and	Control	of
Fractional Order Systems, Part 2							
Prof. Maa	amar Bettay	veb					
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Lectures

Challenging Problems in Approximation, Model Reduction and Filter Design

Prof. Maamar Bettayeb

Practical systems we face in Engineering today are very complex in nature. Examples include data and image processing systems, power and control systems, heat transfer and diffusion processes, large flexible structures, robot manipulators, vibrations, flow, and transportation systems. Modeling, simplification and approximation of these systems are necessary for further analysis, simulation, interpretation and design.

The speaker will formulate several of these problems and present major attractive approaches for their solutions. The speaker will present a unified framework for several important Modeling and Optimization problems in Data Compression, Model Reduction, Rational Approximation, System Identification, Time Series, Filter design and Spectrum Estimation. Such problems arise in Mathematics, Physics, Computer Science and Engineering. Powerful recent approaches to the modeling and approximation of large scale systems are overviewed. Some potential applications are highlighted. Several challenging open problems and extensions are also discussed.

Massive MIMO Systems: Signal Processing Challenges and Research Trends

Dr. Muhammd Moinuddin

The aim of this talk is to present an overview of multiuser multiple-antenna wireless systems with a very large number of antennas, known as massive multi-input multioutput (MIMO) systems. Signal processing challenges and future trends in the area of massive MIMO systems are presented and key application scenarios are detailed. More specifically, several aspects related to transmit and receive processing in massive MIMO systems will be discussed. In the context of transmit processing, challenges in acquisition of Channel State Information (CSI), Pilot contamination, Resource allocation, and Precoding will be outlined. In the context of receive processing, the challenges in Parameter Estimation and Detection Algorithms, Antenna Beamforming and Optimal Antenna selection will be outlined. Future research trends to solve these issues will also be highlighted. Some proposed Massive MIMO Beamforming and Optimal Antenna selection techniques will also be presented.

Solar Photovoltaic Systems and Applications in Buildings

Prof. Abubakr Salim Bahaj

Solar energy offers a free and potentially limitless supply of power. Solar photovoltaics PV is the elegant direct conversion of the sun's radiation into electricity without environmental pollution or the need for fuel or lubricating oils experienced with fossil fuels. The solar electricity is the results of the interception of the sun's energy by a semiconductor device to generate electrical power. The integration of solar cells (or arrays) into surfaces of buildings to produce power that can be utilised within or exported to the grid in many cases has an advantage because the demand for power is in phase with the electrical output of the solar array. The talk will relay to the audience a journey, based on experience, of approaches for utilising solar photovoltaic systems within the places we live in as well as give an overview of the photovoltaic technology. The talk will provide some examples of integrated PV in buildings and economic assessment for their deployment.

Combined Management and Control for Optimal Energy Efficiency of Buildings using Renewable Energy Sources

Prof. Maamar Bettayeb

Energy Consumption in Buildings represents a major part of the overall expenditure. It is extremely important to optimize the use of energy sources in buildings and optimization the energy efficiency. This must be combined with a highly performing control system to ensure comfort in the building.

Renewable Energy Systems are designed to supply power demand in a large number of applications. The aim of any design is to minimize the cost, the size and the energy loss of the hybrid renewable energy system. This optimization problem, using components such as photovoltaic array (PV array), Fuel Cell, Battery and Diesel generator, connected to the electrical grid, is a complex nonlinear problem. Evolutionary Algorithms have proved to be efficient in the solution to these problems. The speaker will formulate several of these problems and present different approaches to apply different approaches to solve them. Challenging issues are highlighted.

Simultaneous Localization and Mapping (SLAM) for Mobile Robots: State of the Art

Dr. Muhammad Shehzad Hanif

One of the main objectives in the field of robotics is to make a robot completely autonomous so that it can navigate independently in an unknown environment. This can only be established if the robot knows its pose (position and orientation) and the map of the environment. However, the robot needs to accomplish this task using its own sensors without external information. This challenging problem called Simultaneous Localization and Mapping (SLAM) is generally solved using state of the art estimation techniques by incorporating motion model of the robot, perception of the environment using sensors and control inputs to the robot. In this talk, the spaeker will present the SLAM problem and its various solutions based on the estimation techniques. Future directions in this important area of research will be also be discussed.

Architectural simplification of Histogram of Gradient based Pedestrian Detector for Implementation on Low Power FPGA

Dr. Muhammad Bilal

Video based pedestrian detection is an important research topic in computer vision and has garnered significant interest from both algorithm and system design perspective. In this scope, Histogram of Oriented Gradients (HOG) feature in combination with Linear SVM classifier is considered to be the single most discriminant detector. Thus almost every pedestrian detector includes HOG as a primary feature along with others in cascaded architectures. However, the computational complexity of HOG alone is prohibitive for inclusion in low power FPGA systems and embedded systems. On the other hand any attempt to approximate its functionality in a bid to reduce complexity results in deterioration of its detection accuracy. In this talk, we will take a look at an approximation technique to capture the essence of HOG shape capturing capability using a simpler feature while mitigating the loss of accuracy through a simplified kernel SVM classifier.

Recent Results on the Identification and Control of Fractional Order Systems, Parts 1 & 2

Prof. Maamar Bettayeb

In this two parts talk, the speaker will present new efficient tuning techniques for the identification and control of integer and non integer fractional systems. Even though fractional calculus is nearly 300 years old, its application to science and engineering in general, and to dynamic systems and control of physical systems in particular, is relatively recent and is considered a new emerging area of research.

First, fractional calculus, a generalization of the notions of integer-order differentiation and integration to non-integer orders is briefly reviewed. New algorithms for system identification of nonlinear systems are presented. The speaker will then develop new algorithms for the tuning of fractional and integer dynamic systems. The resulting fractional IMC-PID fractional controllers represent a major generalization of the well known IMC-PID integer controllers for classical integer systems. The new control scheme is developed for a large variety of dynamic systems including processes with delay. Application to heat flow systems are detailed.

Speakers



Prof. Ubaid M. Al-Saggaf,

Director, Center of Excellence in Intelligent Engineering Systems (CEIES), King Abdulaziz University

Professor, Electrical and Computer Engineering Department King Abdulaziz University

Ubaid M. Al-Saggaf received a B.Sc. with highest honors in Electrical Engineering and a B.Sc. with highest honors in mathematics from King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia. He received his M.Sc. and the PhD in Electrical Engineering from Stanford University, USA. He joined King Abdulaziz University in September 2010 where currently he is the Director of the Center of Excellence in Intelligent Engineering Systems (CEIES) and a Professor at the Electrical and Computer Engineering Department. Prior to that he worked at KFUPM and the Ministry of Defense. His field of interests and specializations cover a wide spectrum from theoretical to practical aspects of engineering including systems, control, signal processing and optronics.



Dr. Abdulsalam Saeed Alghamdi

Director of King Salman ben Abdulaziz Chair for Energy Research King Abdulaziz University

Associate Professor, Electrical and Computer Engineering Department, King Abdulaziz University

Abdulsalam Alghamdi is an associate professor of Electrical Engineering, specialized in Power Systems and Energy. His subspecialty is High Voltage Engineering. He published more than 20 papers, mostly in IEEE international conferences. He graduated from King Abdulaziz University in 1988, with BSc from the Power and Machines group. He got his Masters in Electrical Power Systems and Energy from the University of Manchester Institute of Science and Technology (UMIST) in 1990 and the PhD from the University of Manchester in 1993. He held many academic and administrative roles. He was appointed in 1994 as a Vice Dean for Jeddah College of Technology, and then (1998-2006) as Dean for the college and director for Jeddah Board for Technical Education and Vocational Training, where he was supervising the governmental and private technical education and training institutes in Jeddah area, including two colleges. He led many committees on training and employment. He was the head of Prince Abdulmajeed Office for Training and Employment in Jeddah and was Head of the Ministry of Labour Committee in Jeddah for employment. He participated in many committees in Jeddah Chamber of Commerce and Industry, where he was a member of the Employment in the Marine Sector Committee in Saudi Arabia (initiated by the Minister of Transportation), and he was a member of the Industrial committee and member of Jeddah Office for Education and Employment. He was a guest for many newspapers and TV programs. In 2007, he spent his sabbatical leave in Tony Davies High Voltage Lab in the University of Southampton, where he was granted a Visiting Academic Staff position, valid until 2016. He moved to King Abdulaziz University in 2008, where he joined the Electrical and Computer Engineering Department as an associate professor. Besides the academic duties, he has been directing King Salman ben Abdulaziz Chair for Energy Research since 2013.



Prof.Maamar Bettayeb

Vice Chancellor for Research and Graduate Studies University of Sharjah, United Arab Emirates and Distinguished Adjunct Professor Center of Excellence in Intelligent Engineering Systems (CEIES) King Abdulaziz University

Maamar Bettayeb received the B.S., M.S., and Ph.D. degrees in Electrical Engineering from University of Southern California, Los Angeles, in 1976, 1978 and 1981, respectively. He worked as a Research Scientist at the Bellaire Research Center at Shell Oil Development Company, Houston, Texas, USA., in the development of seismic signal processing deconvolution algorithms for the purpose of Gas and Oil exploration during 1981/1982. From 1982 to 1988, He directed the Instrumentation and Control Laboratory of High Commission for Research in Algeria. In 1988, He joined the Electrical Engineering Department at King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia. He has been Professor at University of Sharjah UAE since August 2000. He is presently the Vice Chancellor for Research and Graduate Studies at University of Sharjah. He has published over 300 journal and conference papers in the fields of control and signal processing. He has also supervised over 50 M. Sc. and Ph. D. students. His recent research interest is in H $^{\infty}$ optimal control, model reduction, signal and image processing, process control, networked control systems, fractional dynamics and control, nonlinear estimation and filtering, soft computing, wavelets, renewable energies and engineering education.



Prof. AbuBakr S. Bahaj

Professor of Sustainable Energy and Electrical Engineering Head of the Energy & Climate Change Division (ECCD), University of Southampton, UK and

Professor of King Salman ben Abdulaziz Chair for Energy Research King Abdulaziz University

AbuBakr Bahaj leads the 55-strong Energy and Climate Change Division at the University of Southampton, where he completed his PhD, progressing from a researcher to a Personal Chair in Sustainable Energy. For more than 25 years, Professor Bahaj has pioneered sustainable energy research and established the energy theme within the University. His major research programmes can be found at www.energy.soton.ac.uk. These include Cities and Infrastructure, Data and Modelling, Energy and Behaviour, Energy and Buildings, Energy for Development, Environmental Impacts, Microgeneration Technologies and Renewable Energy (Solar Photovoltaics and Marine Energy). Professor Bahaj's work has resulted in over 270 articles, published in academic refereed journals and conference series of international standing. He founded the International Journal of Marine Energy (JJOME) which he is the Editor-in-Chief. In 2012, Prof Bahaj was appointed Chief Scientific Advisor to Southampton City Council—believed to be the first such appointment in the UK and in 2014, the UK's Science Council named him as one of the UK's 100 leading practising scientists. In 2014 Prof Bahaj was appointed to Prince Salman ben Abdulaziz Chair for Energy Research at the King Abdulaziz University, Jeddah, Saudi Arabia.



Dr. Muhammad Moinuddin

Department of Electrical and Computer Engineering, and Center of Excellence in Intelligent Engineering Systems (CEIES), King Abdulaziz University

Muhammad Moinuddin received the B.E. degree in electrical engineering from Nadirshaw Edulji Dinshaw (NED) University of Engineering and Technology, Karachi, Pakistan, in 1998 and the M.S. and Ph.D. degrees in electrical engineering from King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia, in 2001 and 2006, respectively. He joined the ECE department at KAU in January 2013 as Assistant Professor. Currently, he has the post of Associate Professor. He is also associated with the Center of Excellence in Intelligent Engineering Systems (CEIES). His research interests are in the area of signal processing, adaptive filtering, wireless communications and Neural Networks. Specifically, he is interested in the application of adaptive filtering in various fields of signal processing. He is the author of approximately 50 peer-reviewed journal and conference papers and one book chapter.



Dr. Muhammad Shehzad Hanif

Department of Electrical and Computer Engineering, and Center of Excellence in Intelligent Engineering Systems (CEIES), King Abdulaziz University

Muhammad Shehzad Hanif is currently working as assistant professor at the Department of Electrical and Computer Engineering, King Abdulaziz University, Jeddah, Saudi Arabia. Dr. Hanif completed his bachelor degree in Electrical Engineering from University of Engineering and Technology, Lahore, Pakistan in 2001. From 2001 to 2005, he worked as design engineer in different R&D companies of Pakistan. In 2006, he completed his MS degree in Engineering Sciences (Specialty: Signals, Systems, Images and Robotics) from Université Pierre and Marie Curie, Paris 06, France. He received his PhD in Computer Engineering in 2009 from the same University. His research interests include machine learning, image analysis, information fusion and, object detection and tracking.



Dr. Muhammad Bilal

Department of Electrical and Computer Engineering, and Center of Excellence in Intelligent Engineering Systems (CEIES), King Abdulaziz University

Muhammad Bilal received B.S. Electronics Engineering from G.I.K Institute of Engineering Sciences & Technology, Pakistan in 2002 and M.S. Computer Engineering and Ph.D. Electrical Engineering from Lahore University of Management Sciences, Pakistan in 2007 and 2013, respectively. He is with Center of Excellence in Intelligent Engineering Systems (CEIES) & Department of Electrical and Computer Engineering, King Abdulaziz University, Jeddah, Saudi Arabia since 2014. Earlier he worked at Center for Integrated Smart Sensors (CISS) at KAIST, South Korea as a post-doctoral researcher. His research interests include system design for image and video processing applications, approximate arithmetic circuits and embedded systems.