1st African Webinar Series on Fundamentals on circuits and Systems and Emerging Technologies

Sponsored by IEEE Circuits and Systems Society

08 October; Webinar1: Register Here

10:00am-13pm (Lecture) and 14:00pm-16:00pm (Practice) time of Ghana

Introduction to Machine Learning

Prof. Tokunbo Ogunfunmi

Santa Clara State University

Abstract: Key concepts in machine learning; topics covered in this lecture include Learning theory; Perceptron Learning Algorithm; Classification vs. Regression models, Supervised learning, Linear Regression; Logistic Regression; Regularization; Neural Networks; Machine Learning System Design; Support Vector Machines; Cross-validation; Unsupervised Learning; Dimensionality Reduction; Anomaly Detection; Examples of applications e.g. Handwriting recognition, Recommender Systems, etc.; Intro to Deep Learning. Software implementations of a typical application using MATLAB or Python. Possible hardware implementations on embedded devices like Raspberry Pi or FPGAs or GPUs are also covered.

Prerequisites: Programming skill e.g. Python or "C" or MATLAB; elementary statistics, linear algebra.

Biography: Tokunbo Ogunfunmi received the B.S. (first class honors) degree from the Obafemi Awolowo University (OAU) (formerly known as the University of Ife), Ile-Ife, Nigeria, and the M.S. and Ph.D. degrees from Stanford University, Stanford, California, all in Electrical Engineering. He is currently a Professor of Electrical and Computer Engineering and Director of the Signal Processing Research Laboratory at Santa Clara University (SCU), Santa Clara, California. From 2010-2014, he served as the Associate Dean for Research and Faculty Development for the SCU School of Engineering. At SCU, he teaches a variety of courses in circuits, systems, signal processing related areas including a new course on autonomous vehicle systems. His current research interests include machine learning, deep learning, speech and multimedia (audio, video) compression, digital and adaptive signal processing and applications and nonlinear signal processing. He has published four books and 200+ refereed journal and conference papers in these areas. Dr. Ogunfunmi served the IEEE as a Distinguished Lecturer from 2013-2014 for the Circuits and Systems (CAS) Society. He has also served in Editorial Boards of IEEE Transactions on CAS-I, CAS-II, Signal Processing Letters. He currently serves on the Editorial Boards of the journal Circuits, Systems and Signal Processing and the IEEE Transactions on Signal Processing.

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09 October; Webinar 2: Register Here

10:00am-12:30pm (Lecture) and 14:00pm-16:30pm (Practice) time of Ghana

Fundamentals of Bioelectronics for Applications in Implantable and Wearable Medical Devices

Prof. Andreas Demosthenous

University College London

Abstract: This webinar provides an introduction to the field of bioelectronics, specifically circuits and systems design and implementation, for applications in implantable and wearable active medical devices. Contents include introduction to biosignals, electrodes, biopotential amplifiers, stimulation electronics, signal processing, power delivery and wireless communication. Several examples of active medical devices are outlined. The accompanying session with hands-on experience provides further insight to the design of multichannel biopotential amplifiers, digital IC design flow for bio-impedance signal processing, including application to human machine interfaces, and data protocol design for wirelessly operated medical devices.

Biography: Andreas Demosthenous received the B.Eng. degree from the University of Leicester in 1992, the M.Sc. degree from Aston University in 1994, and the P.hD. degree from University College London (UCL) in 1994. He is a Professor with the UCL Department of Electronic and Electrical Engineering and leads the Bioelectronics Group. He has made outstanding contributions to improving safety and performance in integrated circuit design for active medical devices, such as spinal cord and brain stimulators. He has numerous collaborations for cross-disciplinary research internationally. He has authored over 300 articles in journals and international conference proceedings, several book chapters, and holds several patents. His research interests include analog and mixed-signal integrated circuits for biomedical, sensor, and signal processing applications.

Dr. Demosthenous was co-recipient of a number of Best Paper awards and has graduated many Ph.D. students. He was an Associate Editor (2006-2007) and the Deputy Editor-in-Chief (2014-2015) of the IEEE Transactions on Circuits and Systems II: Express Briefs, and an Associate Editor (2008-2009) and the Editor-in-Chief (2016-2019) of the IEEE Transactions on Circuits and Systems I: Regular Papers. He is an Associate Editor of the IEEE Transactions on Biomedical Circuits and Systems and serves on the International Advisory Board of Physiological Measurement. He has served on the technical committees for a number of international conferences, including the European Solid-State Circuits Conference (ESSCIRC) and the International Symposium on Circuits and Systems (ISCAS). He is an IEEE Fellow, an IET Fellow and a Chartered Engineer.

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12 October; Webinar3: Register Here

10:00am-13:30pm (Lecture) and 14:00pm-16:30pm (Practice) time of Ghana

Smart Grid and Power Electronics

Prof. Prasad Enjeti

Texas A&M University

Abstract: This course serves as an introductory course to the field of electric energy systems (also known as the "smart grid"). Students are expected to understand the basic concepts behind electric energy conversion and power electronic converters. Utility interface of Renewables (Solar and Wind) via smart inverters, maximum power tracking and importance energy storage will be covered. Finally, emergence of dc and ac micro-grids that have the potential to electrify many parts of Africa are covered.

Biography: Prasad N. Enjeti (M'85-SM'88-F'00) received his B.E. degree from Osmania University, Hyderabad, India, in 1980, the M.Tech degree from Indian Institute of Technology, Kanpur, in 1982, and Ph.D. degree from Concordia University, Montreal, Canada, in 1988, all in Electrical Engineering. He has been a member of Texas A&M University faculty since 1988 and is widely acknowledged to be a distinguished teacher, scholar and researcher. He currently holds the Texas Instruments (TI) Professorship in Analog Engineering. His primary research interests are in advancing power electronic converter designs to address complex power management issues. His recent research focus has been on innovative power electronic solutions to interface renewable energy sources to electric utility. To date he has graduated 35 PhD and 53 MS students. Fourteen of his PhD students currently serve as faculty in institutions at home and across the world while others have leadership positions in industry. He along with his students have over 100 journal publications and received numerous best paper awards from the IEEE. Among the many honors he has received are the IEEE Fellow Award in 2000, Texas A&M University Association of Former Students University Level teaching award in 2001 and the R. David Middlebrook Technical Achievement Award from the IEEE Power Electronics Society in 2012.

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13 October; Webinar4: Register Here

10:00am-13:30pm (Lecture) and 14:00pm-16:00pm (Practice) time of Ghana

Fundamentals on Electronics: A Design Oriented Teaching Methodology

Prof. Jose Silva-Martinez

Texas A&M University

Abstract: It is an exciting time to enter the field of electronic circuit and system design because electronic devices are becoming more widely used in our daily lives year after year. Just to name a few examples: the miniaturization of electronic devices used in implantable devices for health-monitoring applications, cars equipped with various sensors for accident prevention and self-driving capabilities, and cellular phones that surpass the capabilities of desktop computers. This seminar will allow you to explore the subject of electronic circuit design while learning essential analysis, design and simulation methodologies. The key concepts are explained to give intuitive insights for fast understanding and to build a solid foundation of knowledge and skills that can be expanded during future studies.

The characteristics of the basic electronic devices (bipolar junction transistors and metal-oxide-semiconductor field-effect transistors) will be concisely described together with their mathematical and electrical models. Applications, design aspects, and demonstrative simulations are utilized at a very early stage for each topic to provide insights and to show how useful the learned theory is in practical scenarios. The main focus of this seminar is on the analysis and design of basic analog circuits, focused on Junior and Senior Undergraduates.

Biography: Jose Silva-Martinez is currently with the Department of Electrical and Computer Engineering, Texas A&M University (TAMU), College Station, TX, USA, where he holds the title of Texas Instruments Professor. He has co-authored over 135 and 180 journal and conference papers, respectively, three books, and 14 book chapters. He holds five granted patents and five more filed.

Dr. Silva-Martinez will be the Technical Program Chair for ISCAS-2022, and he was the Conference Chair of MWCAS in 2014, and former Senior Editorial Board Member of the IEEE JETCAS 2014-2015, Editor in Chief TCAS-II for the same period. He served as member of CASS Board of Governors (2017-2019), the IEEE CASS Vice President Region-9 from 1997 to 1998. He Co-Advised in Testing Techniques the student that got the 2005 Best Doctoral Thesis Award presented by the IEEE Test Technology Technical Council and the IEEE Computer Society. He was a recipient of the 2005 Outstanding Professor Award by the Electrical Communication Engineering Department, TAMU, recipient of the 1990 IEEE ESSCIRC Best Paper Award, and co-authored the papers that got the RF-IC 2003 Best Student Paper Award and the MWCAS 2011 Best Student Paper Award. Dr. Silva-Martinez is an IEEE Fellow.

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14 October; Webinar5: Register Here

10:00am-13:30pm (Lecture) time of Ghana

Electrified propulsion systems in battery EV and fuel cell vehicles

Prof. Babak Fahimi

University of Texas at Dallas

Abstract: Electrification of transportation industry has gained substantial momentum over the past decade. This trend is a major step towards energy preservation and dependency from fossil fuels. This seminar provides a fundamental understanding of the existing and future trends in electrification of the propulsion systems in battery and fuel cell electric vehicles. Topics ranging from fault tolerance, efficiency, to pollution and sustainability will be discussed. Special emphasis will be given to the role of power electronics and vehicular distribution power system.

Biography: Babak Fahimi is the distinguished chair of engineering and the founding director of the renewable energy and vehicular technology at the University of Texas at Dallas. He received his PhD in electrical and computer engineering from the Texas A&M University on College Station in 1999. Dr. Fahimi has co-authored over 375 scientific articles on his field expertise and has supervised 36 PhD and 21 M.S. thesis to successful completion. He holds 21 US patents and has 6 more pending. Dr. Fahimi is the recipient of IEEE Richatrd Bass young power electronics investigator award in 2003, IEEE Veinott electromechanical energy conversion award in 2005, and the Ralph Teetor educational award from the society of automotive engineering in 2008. Dr. Fahimi is a Fellow of IEEE.

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15 October; Webinar6: Register Here

10:00am-13:30pm (Lecture) and 14:00pm-16:30pm (Practice) time of Ghana

Brain-Inspired Computing: Models and Accelerator Architectures

Prof. Keshab K. Parhi

University of Minnesota

Abstract: With exponential increase in the amount of data collected per day, the fields of artificial intelligence and machine learning continue to progress at a rapid pace with respect to algorithms, models, applications and hardware. In particular, deep neural networks have revolutionized the field by providing unprecedented human-like performance in solving many real-world problems such as image or speech recognition. There is also a significant research aimed at unraveling the principles of computation in large biological neural networks and, in particular, biologically plausible spiking neural networks. Research efforts are also directed towards developing energy-efficient computing systems for machine learning and AI. New system architectures and computational models from tensor processing units to in-memory computing are being explored. Reducing energy consumption requires careful design choices from many perspectives. Some examples include: choice of model, approximations of the models for reduced storage and memory access, choice of precision for different layers of networks and in-memory computing. The half-day tutorial will provide a detailed overview of the new developments related to brain-inspired computing models and their energy-efficient architectures. Specific topics include: (a) Computing models: Perceptrons, convolutional neural networks, recurrent neural networks, spiking neural networks, Boltzmann machines, hyper-dimensional computing; (b) backpropagation for training, (c) Computing architectures: systolic arrays for convolutional neural networks, low-energy accelerators via sparsity, tensor decomposition, and quantization, in-memory computing.

Biography: Keshab K. Parhi received the B.Tech. degree from the Indian Institute of Technology (IIT), Kharagpur, in 1982, the M.S.E.E. degree from the University of Pennsylvania, Philadelphia, in 1984, and the Ph.D. degree from the University of California, Berkeley, in 1988. He has been with the University of Minnesota, Minneapolis, since 1988, where he is currently Distinguished McKnight University Professor and Edgar F. Johnson Professor of Electronic Communication in the Department of Electrical and Computer Engineering. He has published over 650 papers, is the inventor of 31 patents, and has authored the textbook VLSI Digital Signal Processing Systems (Wiley, 1999). His current research addresses VLSI architecture design of machine learning systems, hardware security, data-driven neuroscience and molecular/DNA computing. Dr. Parhi is the recipient of numerous awards including the 2017 Mac Van Valkenburg award and the 2012 Charles A. Desoer Technical Achievement award from the IEEE Circuits and Systems Society, the 2003 IEEE Kiyo Tomiyasu Technical Field Award, and a Golden Jubilee medal from the IEEE Circuits and Systems Society in 2000. He served as the Editor-in-Chief of the IEEE Trans. Circuits and Systems, Part-I during 2004 and 2005. He was elected a Fellow of the IEEE in 1996 and a Fellow of the American Association for the Advancement of Science (AAAS) in 2017

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13 October; Webinar 7: Register Here

10:00am-13:30pm (Lecture) and 14:00pm-16:30pm (Practice) time of Ghana

Conventional and gm/ID Design Techniques for CMOS Operational Amplifiers

Prof. David J. Allstot

Oregon State University

Abstract: In the early 1960s, Robert Widlar designed the world's first monolithic operational amplifier for Fairchild Semiconductor, the μA 702. He dominated analog IC design for the next ten years, and his genius and intuitive insights established analog circuit design techniques that have persisted for decades. They have served the analog IC community well over that time because simple device models were sufficiently accurate to enable quick validation of new design ideas. CMOS analog IC design, for example, has used the small-signal models derived from the simple square-law model introduced by Shichman and Hodges MOS model in 1968. The characteristics of state-of-the-art CMOS devices with minimum feature sizes approaching 7nm can no longer be approximated accurately by the simple square-law models. Still design engineers use those techniques even though they result in initial designs that may deviate from reality by 50-100% (for the nominal process, temperature, and power supply voltage case). Weeks of months of "hand optimization" often follows based on myriad SPICE simulations. The bottom line is that device models are necessarily too complex now to allow for hand analysis and design using simplified models. A design approach that mitigates this problem is the gm/ID-based method introduced by P.G.A. Jespers, et al., in 1996. Rather than the classical intuitive approach based on simple device models, it relies on the use of several SPICE-generated graphs of device characteristics. The graphs are accurate because they are plotted for the specific technology being used. These graphs represent the range of basic design parameters such as small-signal gain, bandwidth, thermal noise power spectral density, etc. As a consequence, the initial gm/ID design is much closer to the desired specifications than using the inaccurate simple device models. This talk will review conventional design techniques for a classical two-stage CMOS operational amplifier followed by the design using gm/ID techniques. Graphs of the device characteristics will be given and the lectures will be followed by a demonstration session.

Biography: David J. Allstot (S'72–M'72–SM'83–F'92–LF'12) received the B.S. degree from the University of Portland, Portland, OR, USA, the M.S. degree from Oregon State University, Corvallis, OR, USA, and the Ph.D. degree from the University of California, Berkeley, CA. He has held several industrial and academic positions. He was the Boeing-Egtvedt Chair Professor of Engineering at the University of Washington from 1999 to 2012 and Chair of the Department of Electrical Engineering from 2004 to 2007. In 2012 he was a Visiting Professor of Electrical Engineering at Stanford University and since 2013 he was the MacKay Professor in Residence in the EECS Dept. at University of California, Berkeley. Dr. Allstot has advised approximately 65 M.S. and 40 Ph.D. graduates, published more than 300 papers, and received several awards for outstanding teaching and research including the 1980 IEEE W.R.G. Baker Award, 1995 and 2010 IEEE Circuits and Systems Society (CASS) Darlington Award, 1998 IEEE International Solid-State Circuits Conference Beatrice Winner Award, 2004 IEEE CASS Charles A. Desoer Technical Achievement Award, 2005 Semiconductor Research Corporation Aristotle Award, 2008 Semiconductor Industries Association University Research Award, 2011 IEEE CASS Mac Van Valkenburg Award, and 2015 IEEE Trans. on Biomedical Circuits and Systems Best Paper Award. He has been active in service to the IEEE Circuits and Systems and Solid-State Circuits Societies throughout his career.

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20 October; Webinar 8: Register Here

10:00am-13:00pm (Lecture) and 14:00pm-16:00pm (Practice) time of Ghana

Data Converters, Calibration, and Testing

Prof. Randall L. Geiger

IOWA State University

Abstract: Data converters are the critical link between the analog information that permeates society and the digital systems that process this information to make it more useful. This workshop will include a discussion of how data converters bridge the analog world and digital systems and how data converters are characterized and specified. The various types of data converters that are used today will be reviewed along with tradeoffs that must be considered when specifying a data converter for a specific application. Both Nyquist-rate and over-sampled data converters will be considered. Details about the internal workings of data converters at the basic component level will be presented along with the inherent challenges engineers face when designing data converters. The effects of random variations in matching critical components on the performance of data converters will be discussed. Calibration strategies will be presented that can be used to offset yield reductions due to random variation of critical components in a data converter. Approaches for testing of data converters will be reviewed. Current research topics focusing on emerging trends in the data converter field will be discussed. The workshop will be concluded with a hand-on opportunity for participants to investigate some of the methods used for characterizing the performance of data converters.

Biography: Randall Geiger is a Professor in the Department of Electrical and Computer Engineering at Iowa State University. Prior to joining Iowa State University, he was a faculty member at Texas A&M University where he was a co-founder of the Texas A&M VLSI program. His research interests are primarily in the analog and mixed-signal area with a focus on precision analog circuit design, data converter design and testing, and more recently on analog hardware security and verification. He is a past president of the IEEE Circuits and Systems Society, a past chair of the Transactions Committee of the IEEE Periodicals Council, a past member of the IEEE Publications Board, and was recently a co-chair of the 2019 IEEE Midwest Symposium on Circuits and Systems. He will be the co-chair of the 2022 IEEE International Symposium on Circuits and Systems. He is a recipient of the IEEE Millennium medal and a Life Fellow of IEEE.

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