2-Day Short-Course on Selected Topics in Mixed-Signal IC Design

By David A. Johns

Date: 24th & 25th June 2019

Venue: University of Limerick

OpAmp Stability and Optimization   1x1.5 hours

This talk will discuss stability as it relates to small and larger circuits. Topics include loop-gain/poles relationship, return-ratio, blackman-impedance, pole-splitting, dealing with positive zero, and nested-miller compensation.

Low-Power OpAmp Design and Biasing (Part I & II)   2x1.5 hours

This talk will discuss opamp design with an emphasis on low power, biasing approaches and transistor sizing. Topics include weak/strong-inversion biasing, design choice of Veff/W/L, constant-current/PTAT/constant-Gm biasing, Rapid multistage analysis, two-stage opamps, telescopic opamps, folded-cascode opamp, differential opamps and common-mode feedback.

Switched-Capacitor Circuit Design   1x1.5 hours

This talk will cover switched-capacitor circuit design. Topics include discrete-time/z-transform, sample-and-hold, SC-integrator, biquad filters, 1/f noise reduction, non-ideal effects.

Oversampled Data Converters   1x1.5 hours

An introduction to oversampled data converters in discrete-time. Topics include noise shaping, stability of higher order modulators, modulator architectures, multi-bit vs single bit, a third-order design example.

Bandpass Delta-Sigma ADCs   1x1.5 hours

This talk will discuss the design of Bandpass Delta Sigma ADCs which are useful in RF systems. Topics covered include resonator structures, architecture choices and example systems.

Incremental ADCs and Sensor ADCs   1x1.5 hours

This talk will discuss the design of incremental ADCs as well as low-frequency sensor data converters. These goal of these converters are to not only have high linearity and SNR but also to have low offset and high accuracy.

Circuit Noise Limitations   1x1.5 hours

This talk will discuss noise in basic circuits and opamps as well as a simple switched-C integrator. Topics covered include device noise basics, amplifier/cascode/mirror/diff-pair noise, switched-C noise, oversampling and differential vs single-ended.

Course Programme

Monday, 24th June 2019

08:30-09:00   Registration & Welcoming

09:00-10:30   Lecture #1 - **OpAmp Stability and Optimization**

10:30-11:00   Coffee Break

11:00-12:30   Lecture #2 - **Low-Power OpAmp Design and Biasing (Part I)**

12:30-13:30   Lunch Break

13:30-14:00   Guest Lecture (Emdalo Technologies) - **"Real World AI Applications"**

14:00-15:30   Lecture #3 - **Low-Power OpAmp Design and Biasing (Part II)**

15:30 -16:00   Coffee Break

16:00-17:30   Lecture #4 - **Switched-Capacitor Circuit Design**

Tuesday, 25th June 2019

09:00-10:30   Lecture #5 - **Oversampled Data Converters**

10:30-11:00   Coffee Break

11:00-12:30   Lecture #6 - **Bandpass Delta-Sigma ADCs**

12:30-13:30   Lunch Break

13:30-14:00   Guest Lecture (UL/CSRC) - **"Computation for Deep Learning"**

14:00-15:30   Lecture #7 - **Incremental ADCs and Sensor ADCs**

15:30 -16:00   Coffee Break

16:00-17:30   Lecture #8 - **Circuit Noise Limitations**

Prof. David A. Johns

David A. Johns - Received the B.A.Sc., M.A.Sc., and Ph.D. degrees from the University of Toronto, Toronto, ON, Canada, in 1980, 1983, and 1989, respectively. In 1988, he joined the University of Toronto, where he is currently a Full Professor. He has ongoing research programs in the general area of analog integrated circuits. Together with academic experience, he also has spent a number of years in the semiconductor industry and was a Co-Founder of a successful IP company called Snowbush Microelectronics, Toronto. He has co-authored over 80 publications including a successful graduate level textbook entitled "Analog Integrated Circuit Design". Dr. Johns is an IEEE Fellow and was a recipient of the 1999 IEEE Darlington Award. He was a Guest Editor of the IEEE JOURNAL OF SOLID-STATE CIRCUITS and an Associate Editor of the IEEE TRANSACTION ON CIRCUITS AND SYSTEMS.
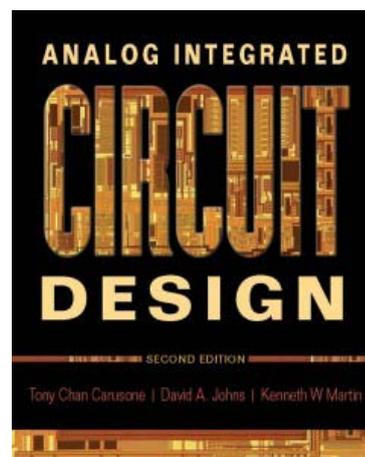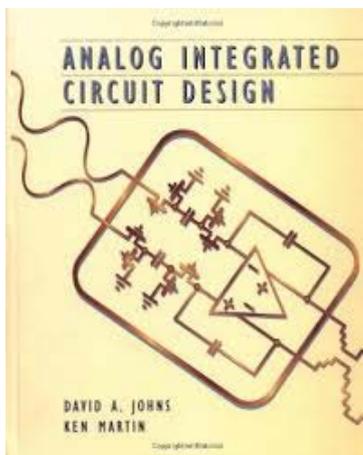
Mr. Daire McNamara

Daire McNamara, Founder Emdalo Technologies. An engineer by training, Daire co-founded Emdalo Technologies in 2013 with Dr. Ivan Griffin to realize Machine Learning at the Edge. Daire has over 20 years experience in the high-tech electronics industries, having held senior commercial, management and product development roles in start-up and early phase companies targeting US, Asia-Pacific and European markets. With Emdalo, he focuses on providing machine learning as a service to clients in areas such as workforce management, security, industrial automation and the marine sector.

About Emdalo Technologies: Emdalo is a software-driven technology company developing advanced edge AI solutions for industries such as industrial automation, workplace management and healthcare, security, marine and subsea. Emdalo provides applied R&D for customers worldwide, offering assistance in prototyping, developing proofs of concept and new products, in software and hardware. Our AI solutions encompass embedded software and hardware, board manufacture, cloud software, and App development across a broad range of technologies such as ARM, RISC-V, TensorFlow, Microsoft Cognitive Services, Caffe, Microsoft Azure, Android and Apple.

Dr. Tony Scanlan

Tony Scanlan received the B.Sc. degree in Experimental Physics from the National University of Ireland Galway, Ireland, in 1998 and completed the M.Eng. and Ph.D. degrees in the area of Electronic Engineering from the University of Limerick, Ireland in 2001 and 2005 respectively. He worked as a design Engineering in Analog Devices, Limerick, Ireland from 1998-2002. He is currently a Senior Research Fellow at the University of Limerick Ireland. His research interests include, data conversion, signal processing, neural networks and machine learning hardware platforms.