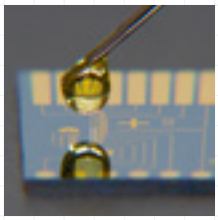
MCCI
Microelectronic Circuits Centre Ireland

TECHNOLOGY CENTRE
SUPPORTED BY ENTERPRISE IRELAND

ANNUAL REPORT 2017



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CHAIRMAN'S MESSAGE

We are at an important time in Ireland as growth returns, and the country positions itself to take part in that growth, particularly in the ICT sector. Fundamental to the emerging trends in ICT, such as Internet of Things, Artificial Intelligence, Cloud and mobile computing, is the development of the microelectronics industry, including semiconductors. Semiconductor technology has been key in driving the massive improvements in performance (and cost) in computers, smartphones, tablets, servers, game systems and other electronics for decades. This is an industry that continues to grow strongly, as new drivers and technology cycles begin to take over from the traditional drivers such as PCs and Mobile.

Cloud computing is driving growth through application-optimised semiconductor technologies to optimise performance, integration and power efficiency. Mobile devices continue to drive growth because of the high degree of chip integration, and the development of sensors, touch controllers and new human machine interface means. The Internet of Things is enabling devices for the likes of smart health, smart grids and smart cities and Artificial intelligence, most of the core algorithms for which were developed several decades ago, but processor performance has reached the point to make neural networks commercially advantageous.

Growth in these areas drives demand for electrical and electronics engineers and circuit designers that can develop the connected devices, sensors, embedded systems and actuators. The rapid developments in micro- and nanoelectronics increase the demand for a range of engineers with strong core engineering skills. The scarcity of people with the right level of experience is the second-biggest challenge according soon to be published reports, and is common across all parts of the ICT industry.

A key trend in the next five years will be the scarcity of students graduating in this discipline. Our ambition is to address this opportunity, attracting the best undergrad students from across Europe to Ireland, and developing them into future leaders in IC design.

Donal Sullivan
Chairman

EXECUTIVE DIRECTOR'S MESSAGE

From circuits to "connect everything" in an Internet of Things to circuits that enable rapid disease detection in farm animals, it has been a year of real progress for us in MCCI. I'm proud of the measurable impact we continue to have through our research excellence, in the application areas of Future Communications, Medical Technologies and Smart Agri.

Our vision is to be the number one Microelectronics research centre globally, for industrial and academic collaboration. Central to that is growing the number of companies that are members of the centre and engaging with us on ground breaking research projects. In 2017 we welcomed 4 more member companies, Cadence Design Systems, Decawave, Helic Research and Intelligent Implants, bringing to 36 companies now joined the centre.

At MCCI our mission is to deliver high impact research outcomes, and by doing so develop our researchers into independent thinkers and future leaders in Irish companies and in the global semiconductor landscape. Since our inception in 2010 we have produced over 70+ peer reviewed publications, 23 of which at Tier 1 Conferences and Journals such as JSSC, ESSCIRC, TCAS-1 and MTT. Central to our success is our core funded team who drive the research agenda for the centre. A key impact of this is growing the talent pool of researchers available to the industry and we continue to exceed expectations on this goal with our alumni now reaching 43.

A highlight of the year has been the growth in the level of funding MCCI generates for Microelectronic Research. From a core grant of €1m we generated a further €6.5m in funding from competitively won research grants through

our industry partners, and other public funding sources. In 2017 we also completed 6 further commercial IP licenses of technology developed for Medtech and SmartAgri applications.

Central to MCCI's strategy is the development of our researchers and students into future leaders within the semiconductor industry. We are proud that we continue to grow our team of engineers and researchers, we now have over 90 researchers working in our teams in Tyndall, UCD and UL.

Microelectronics is a key enabling technology which is enables the major advancements in the ICT sector. As a knowledge economy, if Ireland is to participate in the continued and global economic growth in ICT, a thriving sector in microelectronics is an essential element to ensure we are not left behind.

Donnacha O'Riordan
Executive Director

OUR VISION

We want to be the first choice for Microelectronics research that enables future products and applications. We recognise that Microelectronics is at the heart of all technology, driving and powering the Irish economy. Our vision emphasises high impact research outcomes, but beyond that the development of our researchers into independent thinkers and future leaders in Irish companies and in the global semiconductor landscape. We value the trusted networks of industry-led collaborative research, and commit to timely execution that benefits not only our industry partners, but which contributes fundamentally to a better, more prosperous society.

KEY HIGHLIGHTS

€7.5M
Annual Research Funding

87
Researchers & Engineers

52
Researchers Projects

35
Member Companies

50+
Publications

14
IP Licenses

RESEARCH PILLARS

High Speed Transceivers
Optical and RF.

Power Management
Energy Harvesting, PMIC & Control Algorithms.

Data Converters
High Precision & High Speed.

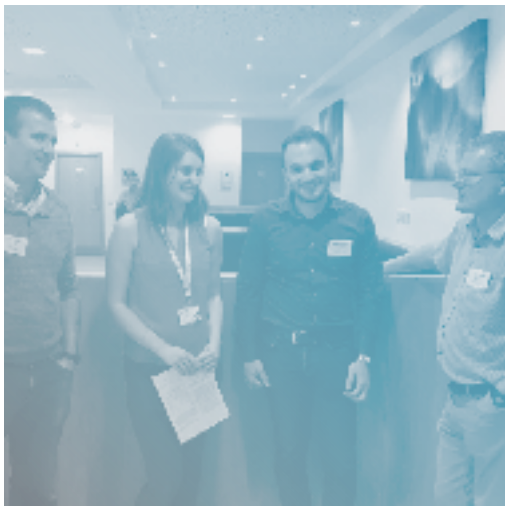
VALUE PROPOSITION

For Industry

- Foremost we provide a single point of contact for industry, to access to academic research across relevant universities.
- With an open Innovation, collaborative research model and transparent IP rules we build trust among our academic and industry partners.
- Clean simple process for IP creation and ownership
- A diverse industry membership gives us access to application knowledge across the value chain that individual members would not have.
- We undertake Research and will develop solutions that push state of the art ensuring global competitiveness for our members, and we are already approaching 70 publications in peer reviewed journals and conferences.

For Academia

- We support Research with state of the art infrastructure, EDA tools, methodologies, processes and support.
- We now have a critical mass of domain experts and thought leaders in our domain.
- We bridge the gap between research and industry and provide a path for fundamental research commercialisation.
- We enable access to a broad representation from industry, across multiple application and technology areas, ensuring relevant, application driven research.



For the State

- Microelectronics is a Key Enabling Technology, enabling the major ICT trends globally, ensuring Ireland Inc. is competitive, and participates in that growth.
- We are developing future employees and leaders ensuring growth in the sector.
- We are growing the Irish talent pool for microelectronic engineering, which secures R&D jobs through active academic interaction and attracts further FDI investment in the sector.
- We provide insight, expert opinion and a forum for innovation, sharing Insight and networking. As a centre funded by state agencies we have influence on national research policy.

OUR OFFERING

We provide a single point of contact for industry which simplifies access to academic research across our partner universities. With an open Innovation, collaborative research model and transparent IP rules we build trust with our partners. Through the development of IC design talent, we are developing future employees and leaders ensuring growth in the sector. We undertake Research and will develop solutions that push state of the art ensuring global competitiveness for our members. With a diverse membership we have access to application knowledge across the value chain that individual members would not have. We provide an infrastructure for members to seed future research ideas and provide expert consultancy for members where capability gaps may exist.

BENEFITS

We are growing the Irish talent pool for microelectronic engineering, which secures R&D jobs through active academic interaction and attracts further FDI investment in the sector. We bridge the gap between research and applications for specialist sectors and products and provide a path for fundamental research commercialisation. Our engagement model provides clarity in the commercialisation process, easing the process of IP licensing. With the agility to respond proactively to industry changes and demands and a research programme focused on problem sets for industry, we are delivering future business value. We provide insight, leading edge IP, expert opinion and a forum for innovation, sharing Insight and networking. As a centre funded by state agencies we have influence on national research policy.

CURRENT MEMBERS

CASE STUDIES

ADC IP GENERATION

Overview

Rohm/Powervation designs and delivers energy-efficient solutions for power-supply systems used in networking, storage and computing applications. The company's digital power IC technology brings fully automatic adaptive control to DC/DC conversion for the first time, in a reliable package that reduces design complexity and cost, increasing power-supply performance and accelerating time to market.

"Engaging with MCCI enabled the external validation from the MCCI research team of the ADC requirements and specifications for the intended application. In addition to the IP licensed as a result of the project, we were delighted to have the ability to identify new talent during the engagement, who were hired once the project was completed".

John Ryan, VP Engineering, Rohm Semiconductor.

Challenges

A critical component of Rohm power-supply controller solution, is an integrated 11 bit Analog to Digital Converter (ADC), which is used to provide precision measurement of the load voltage, load current and other internal system parameters. Rohm had identified the ADC as one of the blocks which limits the performance that can be achieved with their current generation of products. To enable their fourth generation product family, a significant performance improvement in the ADC performance was essential. They came to MCCI to develop a state-of-the art ADC, which would enable a significant performance improvement in their next generation of products.

Benefits of Collaboration

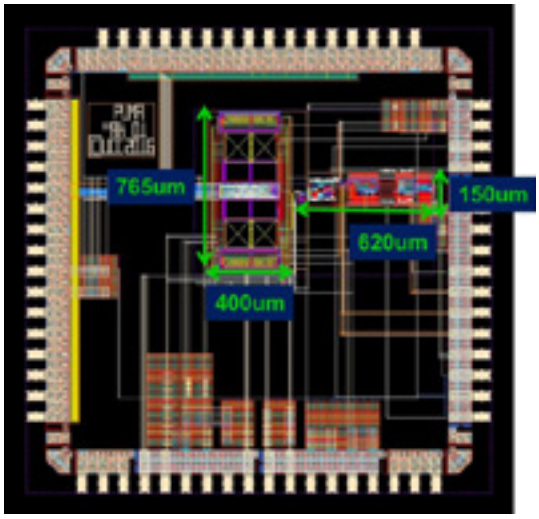
Rohm/Powervation engaged with MCCI under an Enterprise Ireland Innovation Partnership agreement, to research and design a new ADC which met the requirements of their application. MCCI's research expertise was leveraged to deliver significant improvements in the ADC signal bandwidth and latency, increasing the efficiency of the power supply as well as reducing the bill of materials. The ADC performance delivered by MCCI enables new market segment opportunities within the power solutions industry for Rohm.

Research Outcomes

Since engaging with MCCI, Powervation have been acquired by multinational electronics company Rohm. The research collaboration enabled the company to develop new IP as well as attracting top engineering talent. This was an important outcome for the design group at Rohm. The successful collaboration and engagement in the MCCI ecosystem, who have established a track record in attracting world class researchers and transferring them to industry.

The engagement with Rohm is another example of creating real impact from research. An important value add of the centre is the creation and commercialisation of IP to benefit industry. We were delighted to see Rohm look to hire some of the researchers involved in this project, gaining from knowledge transfer through researchers in addition to the digital assets created during the research".

Donnacha O'Riordan, MCCI, Executive Director.



SMART AGRI SENSOR INTERFACE RESEARCH

Case Studies

Overview

AltraTech is an early stage start-up company developing disruptive platform technologies, which brings biotechnology, semiconductors and genetics together; to address needs in the emerging Smart Agri markets. A portable diagnostics kit addresses the emerging worldwide trend of mandatory testing to eliminate pervasive illnesses from herds. Veterinarians can rapidly and accurately identify Persistently Infected (PI) animal on-farm, and immediately remove them to prevent virus spread and re-infection. AltraTech is developing a single-use portable semiconductor test kit for point of care testing of infectious viral diseases. The objective is to decentralize clinical blood testing into 'in the field' point-of-care settings, enabling rapid diagnosis and decision-making on site.

"The research team at MCCI worked with us to make our research idea a reality. We can now work to bring our innovation to market".

Tim Cummins, CEO, AltraTech.

Challenges

To test and identify DNA/RNA, the protocols are only available in a laboratory environment and are both expensive and time consuming. Altratech developed a breakthrough sensor that could identify target DNA/RNA. To bring this innovative product to market they needed sensor interface circuits that would interrogate and read the novel sensor material. A dedicated Application Specific Integrated Circuit (ASIC) was required which integrated the sensor interface circuits and a high precision capacitive to digital converter, with a sensor array.

Benefits of Collaboration

AltraTech worked with MCCI under an Enterprise Ireland Innovation Partnership, which enabled them to leverage the knowledge and experience available in MCCI, to develop a custom ASIC which met the requirements of their unique application. Specifically it allowed AltraTech to leverage the experience of capacitive sensors and capacitive to digital converters within the MCCI team. The collaboration with MCCI has enabled Altratech to raise further, significant VC funding to bring this breakthrough innovation to market.

Research Outcomes

A key innovative element of this platform technology is an ASIC with integrated sensor array. AltraTech worked with MCCI to define the application requirements. An ASIC is required, since a solution based on individual discrete components would not be able to achieve the precision the application required. Secondly, a dedicated ASIC would enable additional new end applications, as well as enabling rapid in-field testing. The primary goal is to enable in-field testing of the resultant solution.

The objective of this research collaboration was to decentralise clinical blood testing into 'in the field' point-of-care settings. This was achieved and enables rapid diagnosis and decision-making".

Donnacha O'Riordan, MCCI, Executive Director.

CUSTOM CHIP DESIGN GENERATION

Case Studies

Overview

Boston Scientific develop solutions for patients suffering from debilitating and life threatening conditions and the healthcare professionals who provide their care. The product innovations they develop enable healthcare providers to deliver effective healthcare by reducing costs and increasing efficiencies. Since the company was founded, it has advanced the practice of less-invasive medicine by providing a broad portfolio of products, technologies and services across a wide range of medical specialties.

"The biomedical circuit research capability in MCCI is now a critical part of securing and growing Boston Scientific's R&D presence in Ireland."

Michael Keane, Process Development Director, Boston Scientific, Clonmel.

Challenges

Implantable electronic devices require very low-power electronics to observe and stimulate the tissue or bio-interface, and these can take years to design and validate. An ubiquitous feature of high-value implantable medical devices is highly customised Application Specific Integrated Circuits (ASIC) which target a specific therapy. The opportunity with this collaboration was to create a versatile implantable microcircuit element to solve the generalised problem of the bio-electronic interface, and to enable the development of novel biomedical therapies.

"We have combined the pacemaker and other novel circuits into a single chip in order to make them smarter, more sensitive and more power-efficient, in addition to reducing form factor."

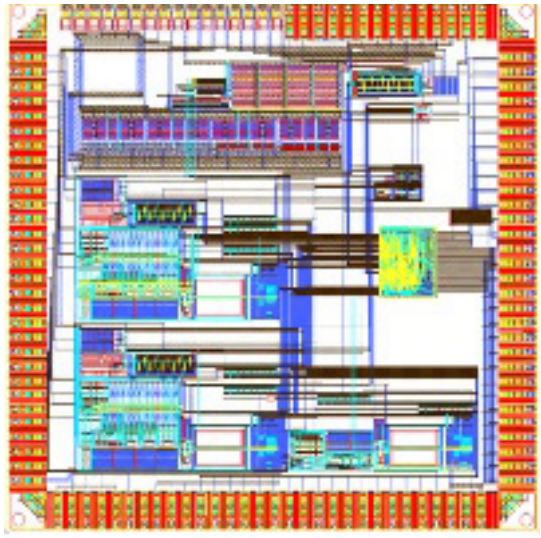
Donnacha O'Riordan, MCCI, Executive Director.

Benefits of Collaboration

Boston Scientific's engagement with MCCI and delivery of the IC will enable the development of next generation therapies using implantable devices. The Innovation Partnership has validated the company's vision to build this microelectronics R&D capability in Clonmel. This is in part due to the proximity of the research expertise MCCI can provide.

Research Outcomes

The bio-interface chip that was developed by the MCCI team will make future systems simpler to design and create opportunities for novel biomedical therapies. The team developed an ultra-low power, custom ASIC that contains all the sense channels and stimulation circuitry required, and fits within a 10-year battery lifetime window. The IC includes stimulation, power management, multiple sense channels for therapy monitoring, and a flexible microprocessor interface to make the chip smarter, more sensitive and more power efficient.



IC DESIGN FOR SILICON PHOTOMULTIPLIER APPLICATIONS

Case Studies

Overview

SensL are the market leaders for extremely low light sensing applications. They have established themselves as an industry leader in the area of Silicon Photomultiplier (SiPM) sensors which rely on the Geiger mode photodiode for operation. SensL also have sensors deployed in Biophotonics, Hazard & Threat Detection and LiDAR (Light Detection And Ranging) products, which are used by companies looking to introduce autonomous vehicles.

"We were pleased with the level of access to tools we got during the collaboration we had with MCCI."

Carl Jackson, CEO SensL

Challenges

There is an ongoing drive for increased levels of integration in the areas of microelectronics and SensL are encountering demands from customers to address this issue. Increasingly, they must integrate their sensor with CMOS logic and develop an IP Library that is compatible with the developed process.

Benefits of Collaboration

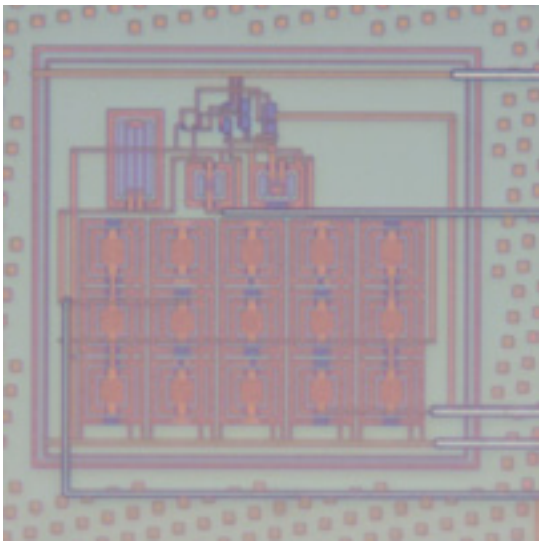
SensL worked with MCCI under an Enterprise Ireland Innovation Partnership, which enabled them to validate how Analogue Mixed Signal designs would perform in this custom CMOS/ sensor process. SensL was able to leverage the existing design infrastructure that exists within MCCI, avoiding the immediate requirement to duplicate that in-house.

Research Outcomes

The development of a custom IP Library to complement SensL's CMOS/sensor process creates a significant opportunity for them. Firstly, it will enable SensL to support higher levels of integration, thereby reducing the cost of production. Secondly, a custom IP Library of building blocks which optimise the achievable performance by SensL's SiPM sensors enables additional market opportunities. Finally, this research will provide SensL with the capability to develop new features for future sensor-based products. This research project enabled continued growth within SensL, in terms of increased revenue, increased margins and profit.

We were pleased that this collaboration enabled SensL to leverage the knowledge and experience available within MCCI to collaborate in the development of a custom Analogue Mixed Signal IP library, which will add significant value to their planned CMOS/ sensor process."

Donnacha O'Riordan, MCCI, Executive Director.



RESEARCHER PROFILES

DR. IVAN O'CONNELL'S TEAM

Dr. Ivan O'Connell

Ivan joined MCCI in 2013 and is the Head of Group of the MCCI core research team. Since joining MCCI he has grown the MCCI core team to 20 researchers, which consists of Masters and PhD students, Postdocs, Research Assistants and Senior Researchers. His primary research interests are in the area of Analogue Mixed Signal Circuits and data converters. He is particularly interested in the application of this research in the application areas including: Internet of Things, Biomedical, Smart Agri and Energy Harvesting. He is currently a principal investigator in a number of Innovation Partnerships and Commercialisation Funds. He is involved in a number of H2020 projects. In addition, he is an SFI CONNECT Funded Investigator and is actively involved in the newly funded SFI centre VistaMilk.

Prior to joining MCCI, Ivan was the Design Manager in ChipSensors, which was subsequently acquired by Silicon Laboratories in 2010. While there, he lead the development of their digital relative humidity and temperature sensor products, from initial concepts, through to initial and interim prototypes, to their subsequent commercialisation, including custom test development.

Since joining MCCI, he has secured €6 million in funding, in addition to 8 commercial licenses and transferring 22 trained researchers to industry. Since 2016, he is a member of the Custom Integrated Circuits Conference Technical Programme Committee.

Dr. Daniel O'Hare, Research Staff

Current Research: High precision ADCs for sensor application.

1. Investigating a novel noise shaped SAR architecture and implementing it using TSMC 28nm HPC CMOS technology.
2. A low noise, high dynamic range Trans-impedance amp for electrochemical sensor interfaces.

Research Topics:

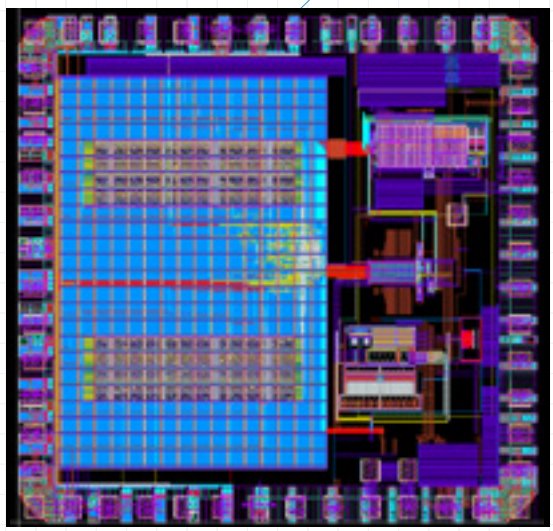
- Low noise, low voltage analogue circuits and interfaces
- Continuous- Time ADCs
- Current sensing interfaces and ADCs
- High precision ADCs and the Buffers to drive them.
- ASICs for sensor applications

Education: PhD Electronic Engineering from University of Limerick (2018)

Thesis title "Design of Continuous Time Input Pipelined ADCs for advanced CMOS technologies"

BE 1st Class Honours UCD (2000)

Top-level chip layout for 1.5GHz Noise-shaped SAR ADC on TSMC 28nm



Anita Schuler, Research Staff

Current Research: 1.5GHz Noise-shaped SAR ADC on TSMC 28nm

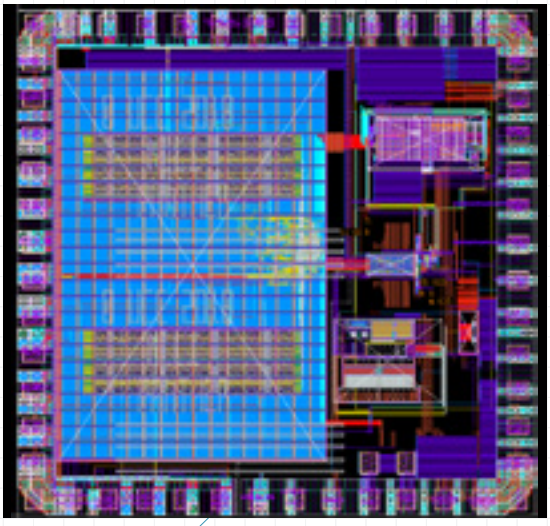
Research Topics: Digital design for ADCs, including specification, design, Verilog RTL Coding, verification, synthesis, place and route and gate-level back-annotated simulations.

Digital PLL on TSMC 28nm

Digital-on-Top auto-routing using Cadence Innovus

Verilog and Digital Design consulting to other groups in Tyndall/UCD

Education: Anita holds a B. Eng (Electronic Engineering), University of Limerick, 1994. First Class Honours.



Top-level chip layout for 1.5GHz Noise-shaped SAR ADC on TSMC 28nm

Subhash Chevella, Research Staff

Current Research: Analog to Digital converters, Comparators, differential Amplifiers.

Research Topics: Analog-Mixed signal circuits, Digitally assisted Analog Circuits

Education: Master of Technology in VLSI from DA-IICT, India

Alberto Dictaldo, Research Staff

Current Research: Developing a complete software platform to handle ADC testing, from outputs acquisition to data evaluation. The software commands all the necessary instrumentation for testing and it calculates the most important parameters that define the quality of an ADC, like ENOB, DNL, INL.

Research Topics: Analogue to Digital Converters, including modelling of new techniques. Testing of ADC using lab instruments and internally designed software.

Education: Alberto holds an MSc in electronic engineering

Università Federico II di Napoli (Italy)

Dr. Gerardo Salgado, Post Doc

Current Research: In this project we are working in the modelling, design, and implementation of SAR ADCs in modern CMOS processes for Internet-of-Things applications, focusing in low power and high resolution data converters design

Research Topics:

- Analogue-to-Digital Converters.
- Digital Signal Processing and Filters.
- Circuits Modelling and CAD tools.
- Mixed Signal Electronic Design.

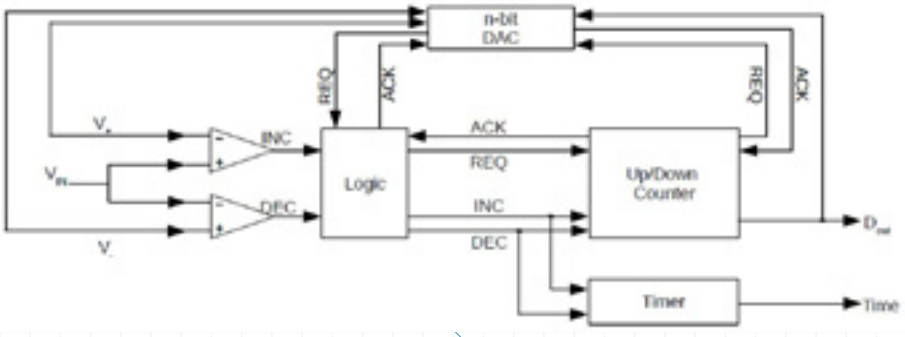
Education: Gerardo received the B.S. degree in electronics engineering from the IT-Puebla, Mexico, the M.S. and Ph.D. degrees in electronics engineering from Institute INAOE, Puebla, Mexico, in 2009, 2011 and 2015, respectively. As part of his PhD studies, he was a visiting student at the Institute IMSE, Seville, Spain and at the Texas A&M University, College Station, U.S.A. He is currently a Postdoc researcher at the Microelectronic Circuits Centre.

Annamaria Fordymacka, PhD Student

Current Research: The research here is on ultra-low power sensor interface ADC for Internet of Things (IoT). Most of the conventional ADCs sample the input signal periodically, which is not efficient for applications where signals are sparse and their frequency content varies with time. The research focus is to investigate different ADC architectures and to develop a new design that could allow us to perform sampling more efficiently.

Research Topics: Low Energy, Data Converters

Education: Annamaria graduated from UCC with a Bachelor's Degree in Electrical & Electronic Engineering in 2014. After her graduation, she joined MCCI at Tyndall National Institute where she completed her Master's degree in 2016. She is currently a PhD researcher in MCCI under the supervision of Dr Ivan O'Connell. The primary focus of her research is mixed signal/analogue IC design.



Level Crossing ADC Architecture

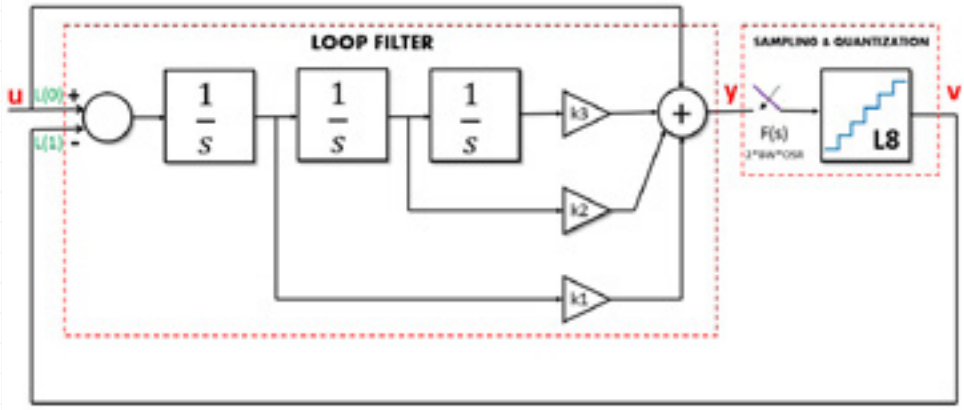
Spyros Kalogiros, PhD Student

Current Research: Development of a continuous-time delta-sigma A/D converter to try to improve the state-of-the-art Schreier Figure-of-Merit performance. A System-Level design of a continuous-time delta-sigma A/D converter has been created-simulated, and the performance limitations (including the non-idealities) in relation to Schreier Figure-of-Merit will be examined for publication & implementation purposes. The next phase, starting in the following months, will be the schematic design of the architecture, in transistor level.

Research Topics: Continuous-Time Delta-Sigma A/D Converters, SAR A/D Converters.

Education:

- (B.Sc.) Electronic Engineering Educator, 2006-2010, School of Pedagogical & Technological Education, Marousi, Athens Greece (www.aspete.gr)
- (B.Sc.) Electronic Engineering, 2010-2011, School of Pedagogical & Technological Education, Marousi, Athens, Greece (www.aspete.gr)
- (M.Sc.) Electronic Physics – Radioelectrology, 2012-2015, Aristotle University of Thessaloniki, Department of Physics, Thessaloniki, Greece (www.physics.auth.gr, elecom.physics.auth.gr)



Delta sigma Modulator Topology

Ian Assom, Masters Student

Current Research: Nowadays the use of wireless communication and inter-connected objects has expanded in many aspects of our daily life. This rapid growth trigger the innovation of integrated circuiteds (IC) to meet the constant increase demand on wireless communication systems. Low power and area consumption are probably the most critical challenges in the modern communication system, hence the ADC architecture choice in the receiver chain is crucial to achieve a truly cost efficient design. Modern Internet-of-Things (IoT) based radio receivers which are multi-tasks and multi-functional are particularly susceptible to external blocker signals and these large interfering signals in adjacent channels are a major constraint which limit receiver performances.

My current research project here at Ireland (MCCI) focuses on developing a low-power, low area and high dynamic range ADC for an IoT radio receiver front end. A continuous time sigma delta ADC (CT ΣΔ) architecture has been adopted due to their implicit anti-aliasing, attenuate out-of-band blockers hence relaxing the requirement, on baseband filtering found in traditional radio receiver system.

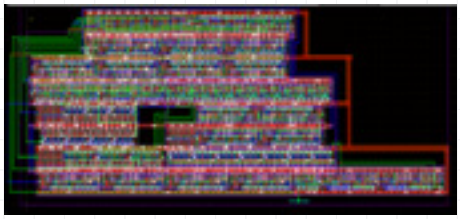
A 4th order single bit CT ΣΔ Modulator with RZ DAC feedback pulse type was implemented in 65nm CMOS process, supporting a supply voltage of 1.2V. A peak signal to quantization noise of 94 DB was achieved.

The proposed single bit design allows for an extremely area and power efficient design along with robustness to clock jitter, ISI and ELD that can meet the strict linearity requirement of a low power IoT based radio receiver.

Research Topics: Low Power/High Resolution Data Converter, CMOS Analog IC Design, Mixed Signal System Modelling & Design, Time to Digital Convert (TDC)

Education: Master's Degree Research in Microelectronic Engineering, University College Cork (UCC).01/2017 – 06/2018

BE Hons: electrical & electronic engineering, University College Cork (UCC).09/2012 – 06/2016



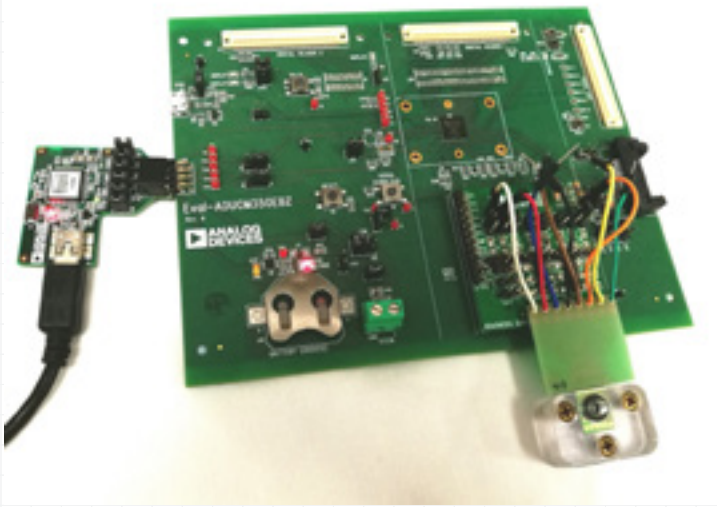
Aidan Murphy, Masters Student

Current Research: The collaboration on this project is with the Nano Technology Group in Tyndall to enable point of care electrochemical sensor detection. A variety of voltammetric techniques have been enabled on the data acquisition system. Results have been accepted for publication at the International Instrumentation and Measurement Conference, Houston, 2018. Current work is focused on enabling more electrochemical tests and miniaturising the system.

Research Topics: Interfacing to electrochemical sensors, in particular, sensors used for on farm disease diagnostics and water quality testing.

Education: Aidan received his BEng degree in Electrical and Electronic Engineering from University College Cork in 2016.

ADuCM350 Evaluation Board with nanowire sensor connected



Gerald O'Sullivan, Masters Student

Current Research: Currently researching methods to improve resolution in Digital to Analogue Converters for high resolution, low power applications.

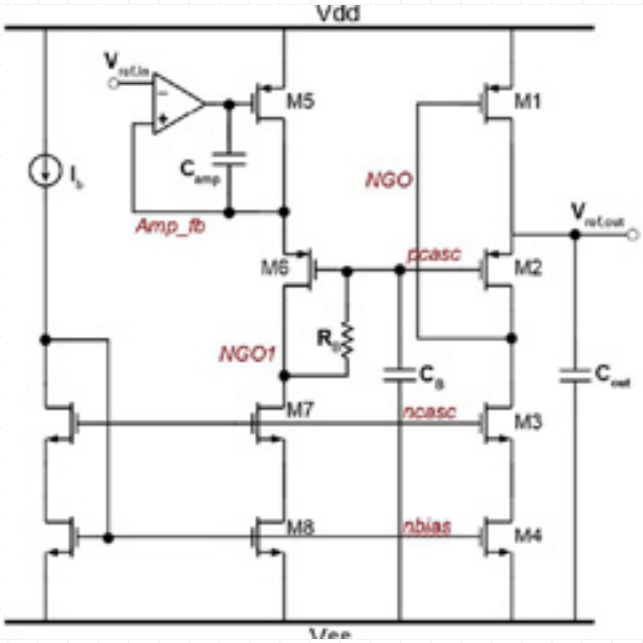
Investigating how to supply a stable reference voltage to the DAC with large current draws and low settling time.

Research Topics: Split Capacitor DAC matching techniques

Reference Buffers to remove oscillations in reference voltage.

Education: Bachelor Degree in Electrical & Electronic Engineering in UCC

Undertaking Research Masters in Mixed Signal Integrated Circuit Design



Kathy Hanley, Masters Student

Current Research: This project focuses on developing a CMOS interface for novel electrochemical sensors developed by the Nano-technology Group in Tyndall. The research has concluded an appropriate architecture and sampling method for the Transimpedance Amplifier and ADC section of this interface which will enable accurate Electrochemical Impedance Spectroscopy (EIS) measurement readings for interdigitated electrochemical sensors. The research has provided valuable insight into the difficulties and challenges encountered while interfacing with Electrochemical Sensors.

Research Topics: This project is focused on developing a CMOS interface for electrochemical sensors, with particular focus on an interface for interdigitated sensors developed here in Tyndall which are used for on farm disease diagnostics.

Education: Kathy graduated from UCC in 2016 with a Bachelors Degree in Electrical and Electronic Engineering. She is currently undertaking her research masters with MCCI at the Tyndall National Institute in the area of Mixed Signal Integrated Circuit Design.

Madhan Venkatesh, Masters Student

Current Research: Ultra low power design for bio-potential acquisition.

Develop design techniques associated with Ultra low power design in deep sub-micron region.

Lead application: bio potential ADC.

A low voltage ADC (300mV - 500mV Supply) for Biomedical and IoT applications.

a. The objective here is to develop an ADC that can operate at low supply voltage,

b. With ENOB ~ 10, Sampling rate ~ 250ksps, power < 500nW.

c. Currently working on Comparator design to optimize the amount of power consumed by it.

The project is to develop a 12-bit ADC, on TSMC 65nm. TSMC 65nm uses a nominal core supply voltage of 1.2V. The goal of the project would be to develop circuits, comparator, sampling switches etc., which can operate at supply voltages of 500mV or lower. Reducing the supply voltage, significantly reduces the associated power consumption and enable a number of applications.

Research Topics: ultra low power SAR ADC design and tapeout (TSMG 65nm)

Education: MEngSc student

Robert Hyde, Masters Student

Current Research: The research focus on this project is on developing an ultra-low power SAR ADC for applications in areas such as wireless sensor networks and wearable devices. The research has focused on the reduction of comparator noise through the implementation and optimisation of majority voting.

Research Topics: Analogue IC design, low-power SAR ADC design, and statistical methods for thermal noise reduction

Education: Robert graduated from University College Cork in 2016 from Electrical and Electronic Engineering, and is currently undertaking a Masters by research in Mixed Signal IC design

SEAMUS O'DRISCOLL TEAM

Seamus O'Driscoll, Research Staff

Current Research Focus: Power Systems integrated on-chip (PwrSoC) or in-package (PwrSiP).

- Point-of-load (POL), multi-phase, multi-level, resonant, hybrid switched-cap and isolated converter topologies.
- Laminated thin-film magnetic device design – on-die and embedded in substrate.
- Solenoidal and closed-core single phase and coupled inductor device design.
- Low voltage switch technologies – Bulk and SOI CMOS, VDMOS, LDMOS, GaN HEMT.
- Ultra-Low-Power (ULP) Control IC architecture and design.
- Gate driver technologies.
- Advanced mixed signal IC architecture.
- Low power inductive coupling.

M.E. by Research: High Dynamic Performance Induction Motor Control

Ruaidhri Murphy, Masters Student

Current Research:

- GaN transistor based voltage regulator modules. GaN is a wide bandgap semiconductor capable of operating at high frequencies. There is potential to implement GaN in high efficiency small footprint voltage converters.
- Integrated inductors. Tyndall's magnetics group is a world leader in on-silicon inductors. Placing inductors on chip enables highly integrable packaging.
- Multi-phase coupled inductor design. Coupling inductors has DC flux cancelation advantages. Smart coupling topologies allows denser inductor solutions.

Research Topics:

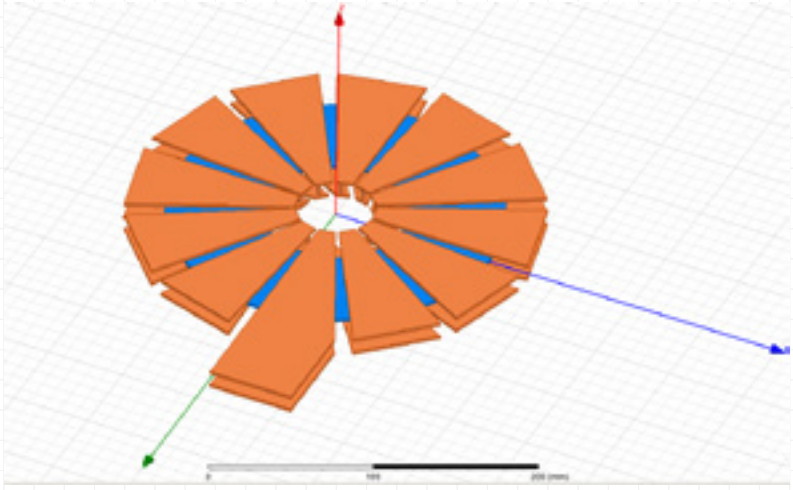
- IC design
- Magnetics

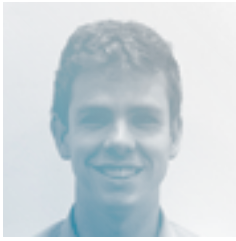
Education:

- Presentation Brothers College Cork
- University College Cork (BE Electrical & Electronic Engineering)

Past experience:

- 24GHz-60GHz Power Amplifier design
- mmWave Phased Array Antenna design
- Monolithic RFIC design





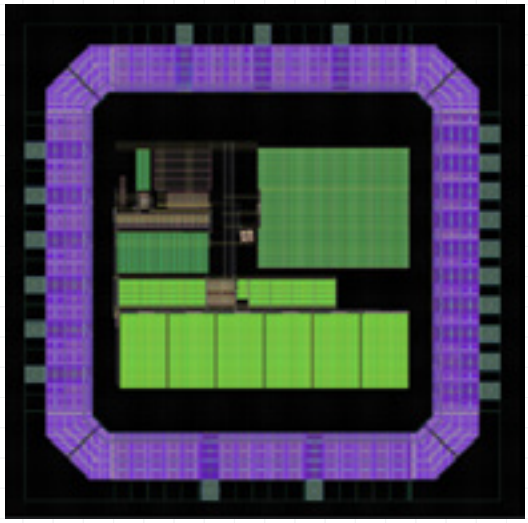
Tim Daly, Masters Student

Current Research: Development of an Ultra-low-power Quasi resonant buck/boost converter IC for applications in Energy Harvesting. Research is focused on the asynchronous low-power digital systems within the IC. Management of analogue and digital sub-blocks integration and communicate correctly at the system architecture level.

Research Topics: Ultra-low-power buck/boost circuits, Ultra-low-power digital synthesis, Power-saving system architectures (granular power), Mixed signal design and validation.

Education:

- Presentation Brothers College Cork, 2006-2012
- University College Cork, Electrical and Electronic Engineering, 2012-2016
- Tyndall National Institute, M.Eng.Sc, 2017-present



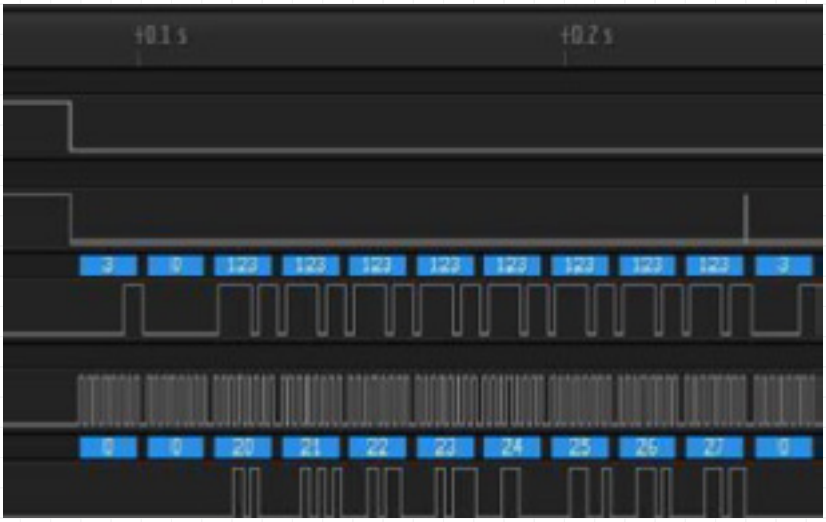
James McCarthy, Masters Student

Current Research: Ultra-Low Power Quasi-Resonant Buck-Boost Converter for application in energy harvesting solutions
Acoustic Sensor mote for predictive maintenance system

Research Topics:

- Design, simulation and layout of the switch mode power supply's power path and gate drivers.
- Analog Mixed Signal Design on 180nm SOI
- State Space Modelling of the converter under all operation conditions
- Characterisation of the acoustic signature of a failing induction motor
- Design of an ultra-low power acoustic sensor for an industry applications

Education:
Bachelor of Electrical and Electronic Engineering, University College Cork



DR. PÁDRAIG CANTILLON-MURPHY'S TEAM

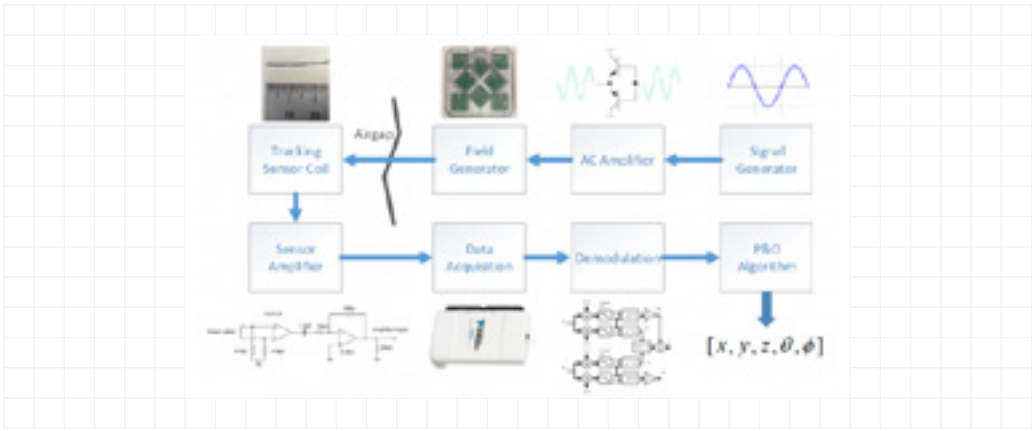
Dr. Pádraig Cantillon-Murphy

Has developed the first open-source electromagnetic tracking platform which can track medical instruments with sub-millimeter accuracy which we have chosen to make available free to the global research community (http://anser.io). Our next generation sensor technology will result from the current work at MCCI and we believe it will drive the platform to be commercially viable.

Education: He is a Lecturer in Electrical and Electronic Engineering at UCC, academic member of Tyndall National Institute & honorary faculty at l'Institut de Chirurgie Guidée par l'Image in Strasbourg. He has a first-class honours B.E. degree in Electrical and Electronic Engineering from UCC and Master of Science and Ph.D. degrees at the Department of Electrical Engineering and Computer Science at Massachusetts Institute of Technology (MIT).

From 2008 to 2010, he was a postdoctoral research fellow with concurrent appointments at Harvard Medical School, Brigham and Women's Hospital, Boston and at the Research Laboratory of Electronics at MIT. He is principal investigator at the Biomedical Design Laboratory at UCC and Tyndall National Institute which explores novel device development in image-guided surgery and endoscopy.

His current research interests include magnets for surgery, electromagnetic tracking and navigation and surgical robotics. He is module coordinator for the UCC Biomedical Design module, an awarding-winning teaching program which couples medical and engineering students at UCC. He is a former Marie Curie fellow (2010-2014), a former MIT Whitaker fellow (2007-08), and a senior member of the IEEE. He has co-founded two start-up companies and is co-inventor on 6 patent applications.



PROF. PETER KENNEDY'S TEAM

Prof. Peter Kennedy

He received his BE (Electronics) degree from UCD in 1984, the MS and PhD from the University of California at Berkeley in 1987 and 1991, respectively, and the DEng from the National University of Ireland in 2010. He joined UCC as Chair of the Department of Microelectronic Engineering in 2000. He served as Dean of the Faculty of Engineering from 2003 through 2005 and as UCC's Vice-President for Research from 2005 to 2011. He moved to UCD in 2017.

He has over 380 research publications (including four patents) in the fields of oscillator design, hysteresis, neural networks, nonlinear dynamics, chaos communication, mixed-signal test, and frequency synthesis. He has worked as a consultant for SMEs and multinationals in the microelectronics industry and is founding Director of the Microelectronics Industry Design Association (MIDAS Ireland) and the Microelectronic Circuits Centre Ireland (MCCI). He won UCC's Invention of the Year Award in 2011 and led the development of the US-Ireland Research Innovation Awards in 2014/15.

He was made a Fellow of the Institute of Electrical and Electronic Engineers (IEEE) in 1998 "for contributions to the theory of neural networks and nonlinear dynamics and for leadership in nonlinear circuits research and education." He has served as Chair of the IEEE Gustav Robert Kirchhoff Award Committee and a member of the IEEE Fellows Committee.

He has received many prestigious awards including Best Paper (International Journal of Circuit Theory and Applications), the 88th IEE Kelvin Lecture, IEEE Millennium and Golden Jubilee Medals, and the inaugural Royal Irish Academy Parsons Award in Engineering Sciences.

In 2004, he was elected to membership of the The Royal Irish Academy and was made a Fellow of the Institution of Engineers of Ireland by Presidential Invitation. From 2005 to 2007, he was President of the European Circuits Society and Vice-President of the IEEE Circuits and Systems (CAS) Society (with responsibility for Europe, Africa and the Middle East). He was made a Fellow of the Irish Academy of Engineering in 2014. He was elected to membership of Academia Europaea in 2015.

During 2012 and 2013, he was as a Distinguished Lecturer of the IEEE CAS Society. He was elected Secretary for International Relations of the Royal Irish Academy in 2012. The following year, his RIA portfolio was expanded to include Policy. He has been President of the RIA since 2017.

Yann Donnelly, PhD Student

Current Research: Divider controllers for optimized spectral performance of fractional-N frequency synthesizers in the presence of loop nonlinearities

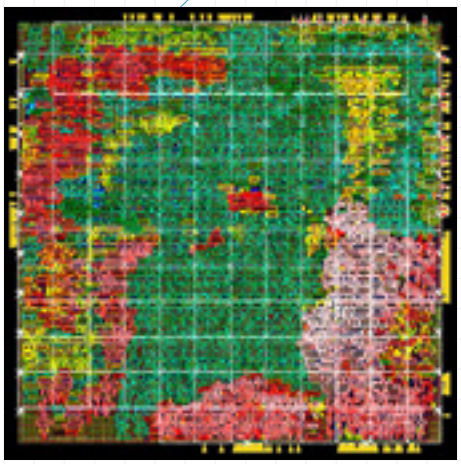
Spurious spectral components on the outputs of PLLs have previously been linked to interactions between modulator-induced phase noise and loop nonidealities. The overarching goal of the project is to develop strategies for reducing these nonlinearity-induced spurs.

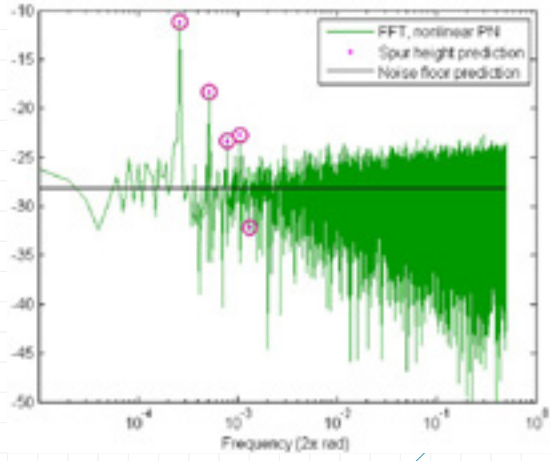
The project has succeeded in developing an understanding of and theoretical predictions for nonlinearity-induced phase noise and wandering spurs. A number of PLL modifications have been developed and are being verified in a silicon implementation..

Research Topics: Frequency synthesis, PLLs, phase noise, fractional-N spurs.

Education: BE (Electrical & Electronic) – University College Cork, 2014

Multi-purpose divider controller





Comparison of semi-analytical predictions of noise floor (black) and spurs (magenta) and simulated behaviour (green)

Luca Avallone, PhD Student

Current Research: Advanced Frequency Synthesis

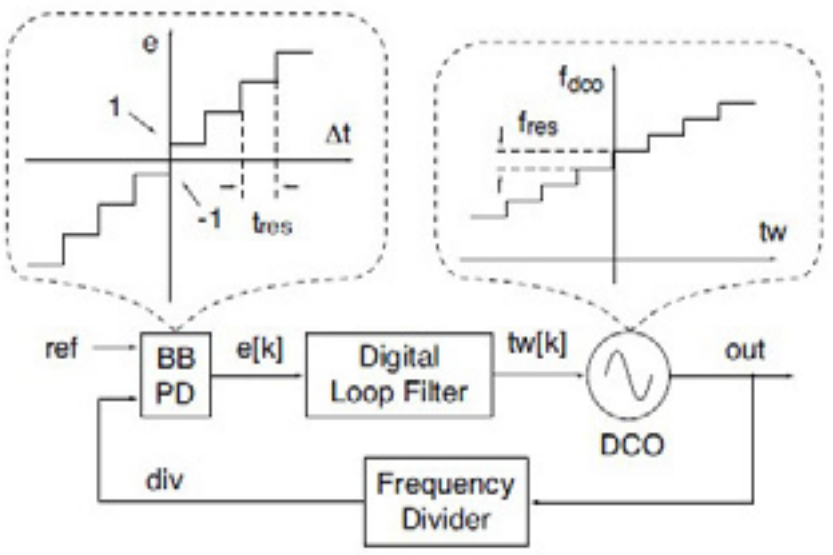
Research Topics: Fractional-N Bang-Bang Digital PLLs.

- State-of-the-art of the fractional-N structure identifying its main limits and problems;
- Development of a theoretical analysis of fractional-N Bang-Bang Digital PLLs;
- Implementation of a new solution focusing on the BBPD and the Frequency Divider.

Education: Bachelors Degree in Electronic Engineering at University of Naples Federico II, 14/03/2014

Masters Degree in Electronic Engineering at University of Naples Federico II, 28/09/2017

All-digital phase-locked loop with quantized phase and frequency



Dawei Mai, PhD Student

Current Research: High-Performance Fractional Frequency Synthesis

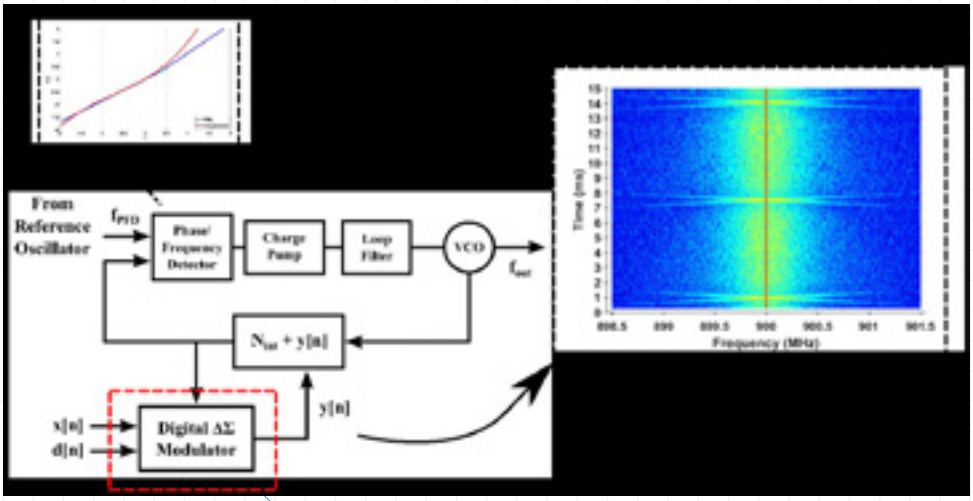
Abstract: In the traditional phase-locked loop, the divider controller contributes significantly to the output phase noise. The conventional multi-stage noise shaping delta-sigma modulator divider controller (MASH-DDSM divider controller) with a large input word length will induce periodic spurious tones in the output phase noise spectrum. The aim of the research is to understand the phenomenon to provide insight into the cause of it and finally to provide solutions to eliminate the periodic tones.

Other components in traditional analog and digital frequency synthesizers impose limits on their performance. For example, the fractional input to the digitally controlled oscillator will add noise to the output phase noise. The exploration of those limits is another topic of the research.

Research Topics: Frequency synthesis, phase-locked loops, circuit theory

Education: Bachelor of Engineering (2015), University College Cork

Master of Engineering (2018) University College Cork



Spectrogram of phase-locked loop output signal exhibiting X-shaped wandering spurs caused by interaction between the digital modulator and nonlinearity in the loop

Salvatore Galeone, PhD Student

Current Research: RTWOs as multiphase oscillators for frequency synthesizers

The Rotary Traveling Wave Oscillator is an oscillator topology based on a transmission line rather than a lumped resonator. The RTWO operates by propagating a traveling wave along a differential transmission line that is closed in a Möbius connection. The losses of the transmission line are restored by distributed CMOS amplifier stages.

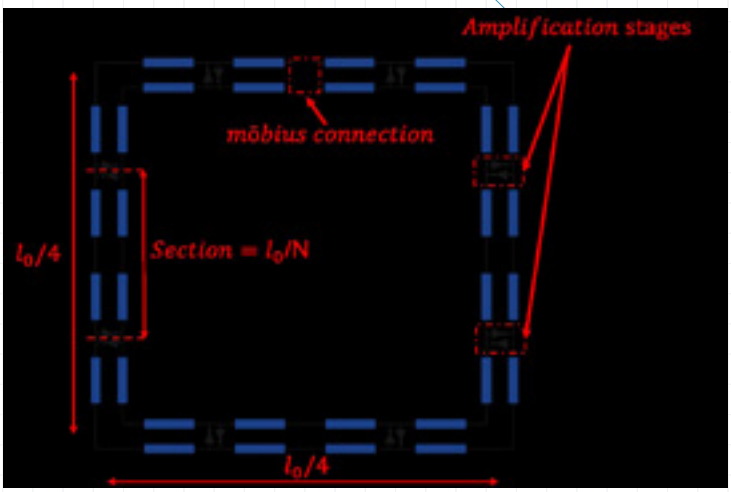
This oscillator topology is attractive for the intrinsic multiphase nature of the oscillator and its ability to operate a very high frequency with low phase noise and power consumption.

Research Topics: Oscillators, phase noise

Education: 2009 Bachelors' degree in Electronic engineering from University of Pavia, Italy

2012 Masters' degree in Electronic engineering from University of Pavia, Italy

A rotary traveling wave oscillator is comprised of a Möbius connection of multiple sections of transmission line, with amplification stages in between to compensate for losses in the line



Valerio Mazzaro, PhD Student

Current Research: Frequency synthesis

Performance limits for PLL architectures.

The purpose of this project is to investigate and analyse the performances and limits of different topologies of PLL, with emphasis on the fractional divider block.

Research Topics: Frequency synthesis, PLL design

Education: Valerio holds a Bachelors Degree in Electronic Engineering at University of Naples Federico II, 14/12/2014

Masters Degree in Electronic Engineering at University of Naples Federico II, 28/9/2017

PROF. BOGDAN STASZEWSKI'S TEAM

Prof. Bogdan Staszewski

In Sept. 2014 Prof Staszewski joined University College Dublin (UCD) as a Professor while still holding a part-time Professor position at TU Delft. Prior to 2014, he was at Delft University of Technology (TU Delft) in the Netherlands, where he held academic positions since 2009. He joined TU Delft in 2009 after 18 years in industry with diverse experience in microelectronics and communication systems. He is an IEEE Fellow for contributions to the digital RF communications systems. In 2012, he won the prestigious IEEE Circuits and Systems Industrial Pioneer Award. He has co-authored three books, six book chapters, 170 journal and conference publications, and holds140 issued US patents.

Professional experience: University College Dublin. Position Professor in the School of Electrical, Electronic & Communications Engineering. Carrying out research and teaching in the area of microelectronic circuit design; concentrating in frequency synthesis and RF using advanced CMOS for Internet-of-Things (IoT).

Delft University of Technology (TU Delft), Delft, the Netherlands. July 2009 to present. Carrying out research and teaching in the area of microelectronics, concentrating on frequency synthesis and RF using advanced CMOS.

From 1995 to 2009, he was with TI Dallas, where achievements included the invention and development of the Digital RF Processor (DRP) technology: A novel all-digital frequency synthesizer, all-digital RF transmitter and discrete-time RF receiver architecture that is suitable for the mainstream digital CMOS processes and presents a unique opportunity to build ultra low-cost and power-efficient single-chip radios. Developed a new digitally-intensive CMOS read channel architecture for magnetic recording hard-disk drives. Prior to TI he worked with Alcatel Network Systems, Texas from 1991 – 1995, included work in telecommunications systems, discrete analog and digital circuits, high-speed signal integrity, software algorithms.

Education: Ph.D. in Electrical Engineering, University of Texas at Dallas, USA. Thesis "Digital deep-submicron CMOS frequency synthesis for RF wireless applications," July 2002. M.S. in Electrical Engineering, University of Texas at Dallas, USA, with concentration in digital systems, Dec. 1992. B.S. in Electrical Engineering, Summa Cum Laude, University of Texas at Dallas, USA, with concentration in telecommunications, May 1991.

Paulo Vieira, Research Staff

RF and millimeter-wave measurements.

Paulo graduated from Cork Institute of Technology (CIT), Ireland in 2006 with a Bachelor degree in Electronic Engineering and a Master degree in Telecommunications Engineering in 2010. He spent seven years working as a RF Engineer at M/A-COM Technology Solutions in Cork, Ireland, where he found his passion for the RF/Microwaves field, before starting his new challenging job as a Senior Research Support Engineer at University College Dublin (UCD).

Dr. Ka-Fai, Post Doc Researcher

Dr. Ka-Fai Un has been a postdoc researcher at UCD since January 2017 and has been a lecturer (Macao Fellow) with the State Key Laboratory of Analog and Mixed-Signal VLSI, University of Macau (UM), Macao, China, since Dec 2015. He was a postdoc researcher at UM since Sep 2014. He received the M.Sc. and Ph.D. degree in electrical and electronics engineering from UM in 2009 and 2014, respectively. He received the B.Sc. degree in electrical engineering from National Taiwan University, Taipei, Taiwan, in 2007.

He was a PhD student recipient of the Postgraduate Science and Technology Research and Development Award, FDCT, Macao, China, in 2012. He was also a recipient of the 2008 APCCAS Merit Student Paper Certificate.

His research interests are:

1. RFDACs,
2. Wideband wireless transmitters,
3. Harmonic rejection mixers,
4. Switched-capacitor circuits,
5. Multi-phase local oscillator generators,
6. Baseband modulations and signal processing.

Dr. Cagri Cetintepe, Post Doc Researcher

Dr. Cagri Cetintepe has been a postdoc researcher at UCD since June 2016. He received his PhD, MSc and BSc degrees in Electrical and Electronics Engineering, all with high honors, from Middle East Technical University (METU), Ankara, Turkey, in 2015, 2010, and 2007, respectively. His MSc and PhD research experience spans areas such as radio frequency microelectromechanical system (RF MEMS) switches and phase shifters, surface micromachined passive lumped components, antennas, microwave and millimeter wave instrumentation, and radar/communication applications.

His research interests are:

1. RF and millimeter-wave transceivers,
2. On-chip antennas,
3. Analog and mixed-signal ICs.

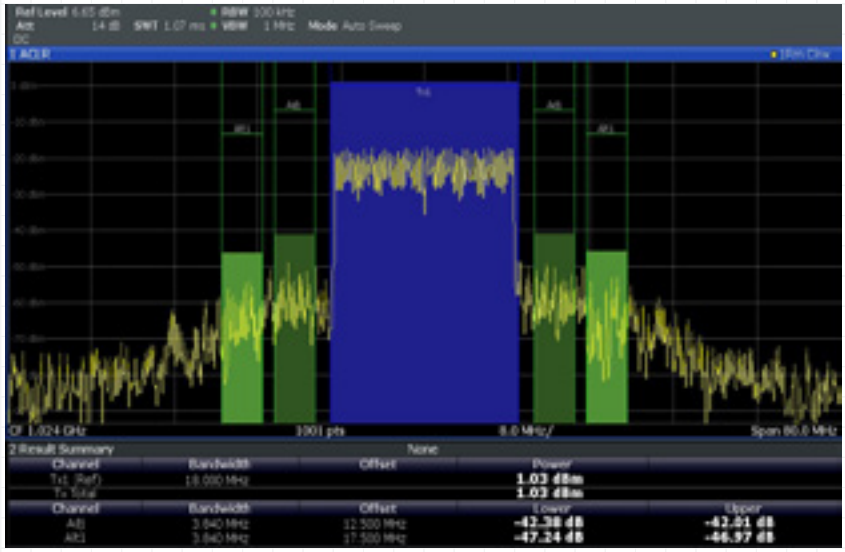
Dr. Pedro Emiliano Paro Filho, Post Doc Researcher

His research interests are:

1. RF transceivers,
2. RFDACs,
3. Reconfigurable Frontends,
4. Analog and mixed-signal ICs.

Pedro received the B.Sc. and M.Sc. degrees in Electrical Engineering from the University of Campinas, Brazil, in 2009 and 2012, respectively. In 2016, Pedro Paro Filho received his Ph.D. degree with highest honors from IMEC and the Vrije Universiteit Brussel (VUB), for his research on charge-based transmitter architectures. His interests involve different aspects of RF transceivers design, including reconfigurable front-ends and low power radios.

Dr. Paro Filho received the ISSCC 2015 Jan Van Vessem Award for Outstanding European Paper, granted by the IEEE Solid-State Circuits Society.



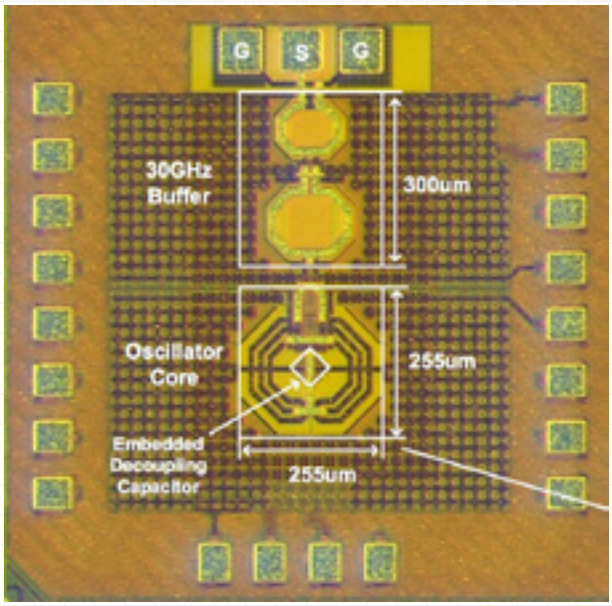
Dr. Teerachot Siriburanon, Post Doc Researcher

Dr. Teerachot Siriburanon has been a postdoc researcher at UCD since January 2016. He received his PhD and MSc degrees in Physical Electronics from Tokyo Institute of Technology, Japan in 2016 and 2012, respectively. He received his BSc degree from Sirindhorn International Institute of Technology, Thammasat University, Thailand in 2010.

He is the current recipient of a Marie Sklodowska-Curie Individual Fellowship, which is supporting his research on Wave-Locked Loop for Frequency Synthesis (WLL). He won the prestigious IEEE Solid-State Circuits Society Predoctoral Achievement Award 2015-2016.

His research interests are:

1. ADC-assisted ADPLL,
2. Class-C VCO,
3. Millimeter-Wave PLLs.



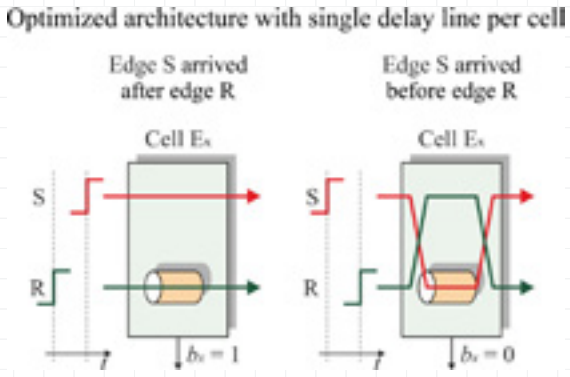
Dr. Filippo Schembari, Post Doc Researcher

Dr. Filippo Schembari has been a postdoc researcher at UCD since January 2016, He received his PhD degree in Information Technology at Politecnico di Milano, Milan, Italy in 2016, working on the development of analog and mixed-signal readout ASICs for silicon radiation detectors (SDDs and CCDs) for X- and Gamma-ray spectroscopy and imaging applications.

He received his MSc degree in Electrical Engineering in 2012 and BSc degree in Biomedical Engineering in 2010, both degrees from Politecnico di Milano, Milan, Italy with Summa cum laude in both degrees respectively. He is the current recipient of a Marie Sklodowska-Curie Individual Fellowship, which is supporting his research on time-domain solutions for analog-to-digital conversion.

His research interests are:

1. Oscillator-based A/D converters,
2. Level-crossing-sampling digitally-intensive ADCs,
3. High-speed time-interleaved SAR ADCs,
4. Successive approximation time-to-digital converters,
5. Voltage-to-time-converter-based ADCs.

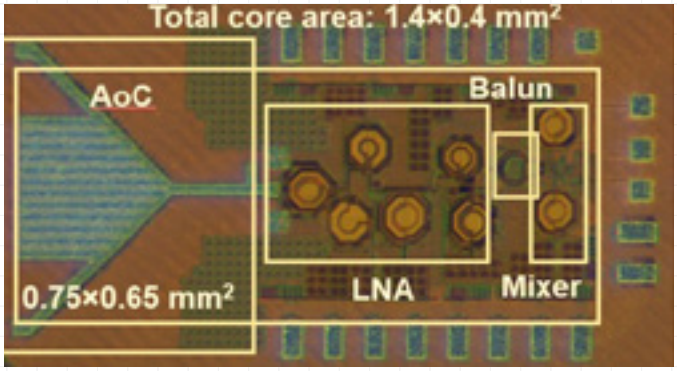


Mahsa Keshavarz Hedayati, PhD Student

Mahsa Keshavarz Hedayati is a visiting PhD candidate researcher at UCD since 15 September, 2015. She is currently pursuing her PhD in Electrical Engineering (Field and Wave Telecommunication Engineering) at Amirkabir University of Technology (AUT, Former Tehran Polytechnic), Tehran, Iran since 2012. She received her MSc and BSc degrees in Electrical Engineering from Amirkabir University of Technology, Tehran, Iran, respectively in 2011 and 2008.

Her research interests are:

1. Microwave and millimeter-wave devices modeling and simulation,
2. RF, Microwave and MMIC circuits,
3. Numerical Methods in Electromagnetic,
4. Active and passive device modeling,
5. Active integrated antenna,
6. Optical communication



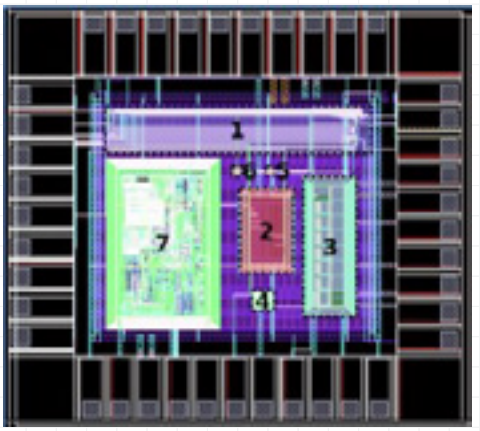
Dennis M. Andrade Miceli, PhD Student

His research interests are:

1. Process variability, Voltage and Temperature fluctuations aware design.

Chip micrograph

Dennis graduated from Veracruz Institute of Technology, Veracruz, Mexico in 1998 with a Bachelor degree in Industrial Electronic Engineering and a Master degree from the National Institute of Astrophysics, Optics and Electronics (INAOE), Puebla, Mexico in 2002 in Electronic Engineering. He has worked as Electronic Engineer, IC designer, and staff researcher for different companies and universities (Maritime Mexican Transportation, Technical University of Catalonia, ARQUIMEA, and UCD).

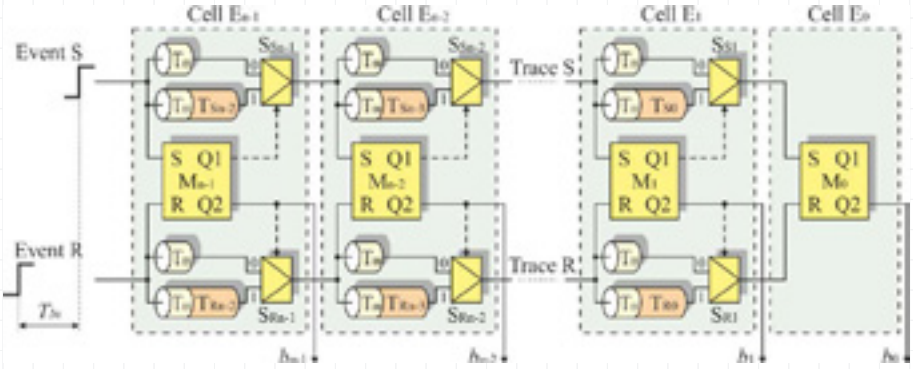


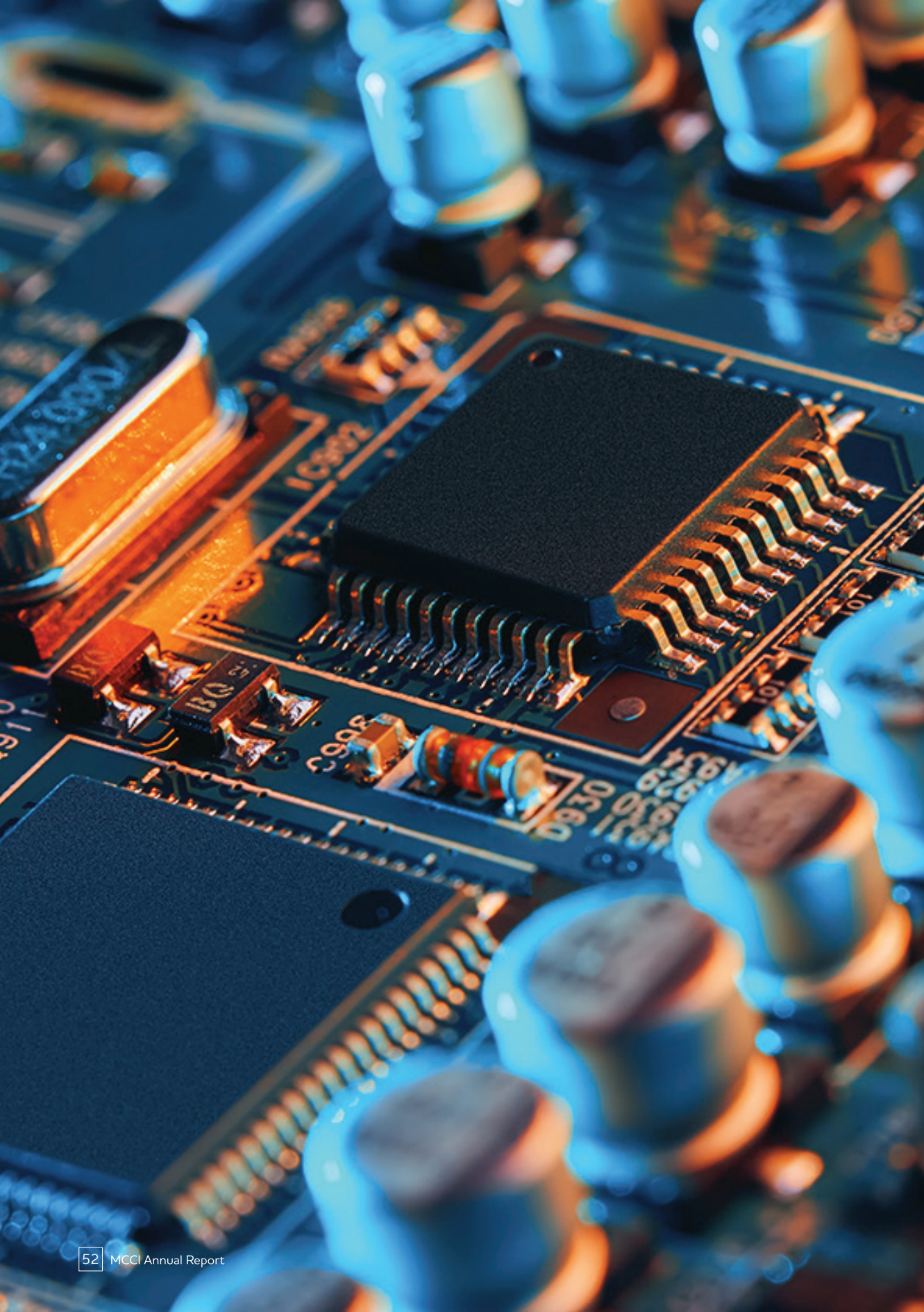
Jakub Szyduczynski, PhD Student

Jakub Szyduczynski is a visiting PhD student at UCD (since September 2017) and he is a research assistant at Department of Electronics, AGH University of Science and Technology, Krakow, Poland (since December 2012). He received the B. Sc. and M. Sc. degrees in Electronics and Telecommunication from the AGH University of Science and Technology, Krakow, Poland, in 2010 and 2012, respectively.

His research interests are:

1. Analog and Mixed-Signal Integrated Circuit design,
2. Time-mode data conversion and signal processing,
3. Data converters.



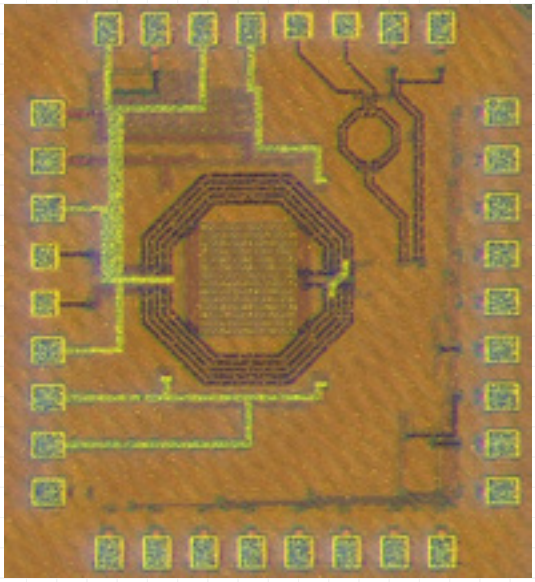


Peng Chen, PhD Student

Peng Chen has been a PhD student at UCD since September 2015. He received his MSc degree in Microelectronic at TU Delft, Delft, Netherlands, in September 2014 (MSc thesis done at IMEC Holst Center in Eindhoven, NL) and worked for one year for Huawei in Amsterdam.

His research interests are:

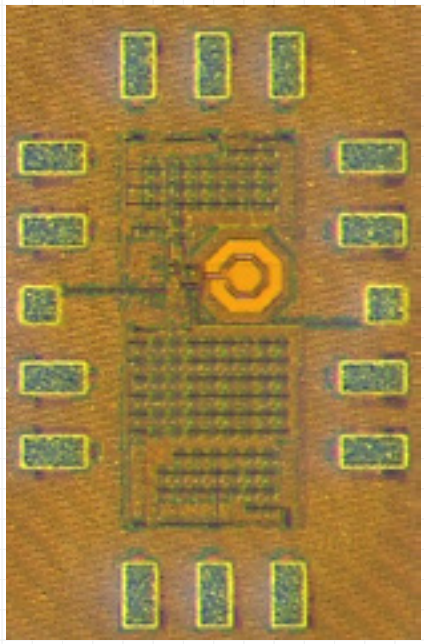
1. Sigma-delta TDC in TSMC 40 nm technology,
2. DTC which is also used in a new ADPLL,
3. ADPLL for blue tooth application.



Amir Bozorg, PhD Student

1. Radio frequency mm-wave IC design,
2. Wideband transceivers design (PA, LNA, VCO and Mixer),
3. Discrete-time receivers design,
4. Phase locked loops and frequency synthesizers,
5. Mixed-signal ICs implemented in CMOS technology.

He received his MSc degree in Microelectronics from Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran in 2012 . He collaborated as a research associate with IC Design laboratory at Amirkabir University of Technology, Tehran, Iran in 2013 where he designed several wideband LNAs for cognitive radios and TV applications. He worked as a lecturer in Electrical Faculty of Sattari University, Tehran, Iran, in 2014. He joined Mobin R&D group in Tehran, Iran, in 2015 where he designed discrete RF transceivers, PLLs, and synthesisers.

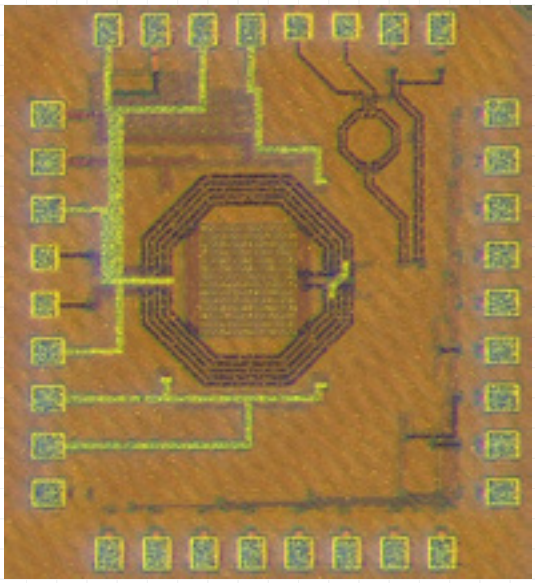


Feifei Zhang, PhD Student

Feifei Zhang joined the group in February 2017 after she became a PhD student at UCD in September 2014. She received her MSc of Microelectronics in Beijing Embedded Key Lab from Beijing University of Technology, China in 2014, and BSc of Navigation guidance and control from Beijing University of Aeronautics and Astronautics, China in 2011.

Her research interests are:

1. RFDAC,
2. Digital Calibrated Pipelined ADC,
3. Class-E PA.



Hongying Wang, PhD Student

Hongying Wang has been a PhD student at UCD since July 2016. She received her MSc and BSc degrees in Microelectronics from Harbin Institute of Technology, Heilongjiang Province, China in 2016 and 2013, respectively. Her Msc and BSC thesis are about Delta-Sigma A/D converter design

Her research interests are:.

1. Data converter design,
2. Analog and mixed-signal Circuit design,
3. RF system design.

Hieu Minh Nguyen, PhD Student

Hieu Minh Nguyen has been a PhD student at UCD since November 2017 (co-supervised with Prof. Anding Zhu). He received his MSc degree in Electronic Engineering and BSc degree in Electronics and Telecommunication Engineering from Ho Chi Minh City University of Technology in 2016 and 2014. During 2013–2014, he joined Integrated Circuit Design Research and Education Center where he studied Analog and RF integrated circuit design. He also received Award of Best Student in Analog IC Design for the design of 24-Bit Delta-Sigma ADC.

His research interests are:

1. Analog and Mixed-Signal IC Design,
2. Radio Frequency IC Design,
3. RF-DAC, Fully Digital Transmitter for wideband,
4. Hybrid Data Converter for High-speed applications, Multimode LDO for Battery Charger,
5. TCAD modelling for CMOS device

Jianglin Du, PhD Student

Jianglin Du has been a PhD student at UCD since July 2016. He received his MSc degree in Physical Electronics and BSc degree in Micro-Electronics from Jilin University, Jilin Province, China, respectively, in 2016 and 2013.

His research interests are:

1. Flat-panel display design and high-speed optoelectronics,
2. CMOS integrated circuit design,
3. Organic optoelectronic materials and devices,
4. Semiconductor Physics.

Kai XU, PhD Student

Kai XU has been a PhD student at UCD since September 2015. He received his MSc degree in Microelectronics from Peking University, Shenzhen, China, in July 2015. He received his BSc degree in Electronic Information Science and Technology from Shandong Normal University, China in July 2012. He was a visiting researcher at University of Ghent in Belgium.

His research interests are:

1. Mixed signal design for IEEE 802.11ah wireless transceiver,
2. Wideband RFIC design (PA, LNA, Mixer),
3. Modeling of high speed optical fiber communication systems,
4. High speed equalizer design for Multimode Fiber links,
5. Analog IC design (OPAMPs, Bandgap references).

Yizhe HU, PhD Student

Yizhe HU has been a PhD student at UCD since April 2015. He received his BSc degree in Electrical Engineering from Harbin Institute of Technology, Harbin, China, in July 2013.

His research interests are:

1. Architectures of PLL for FMCW radar applications: fractional-N, ADPLL, and mixed-mode,
2. Mixed-signal circuit design,
3. Current-mode signaling (CMS) scheme.

Naser Pourmousavian, PhD Student

Naser Pourmousavian has been a PhD student at UCD since December 2014. He received his MSc degree (cum laude) in Electrical Engineering from KU Leuven, Belgium, in 2014. He received his BSc degree Electrical Engineering from Sharif University of Technology, Tehran, Iran in 2012.

His research interests are:

1. Fully integrated switched-capacitors DC-DC converters,
2. Analog and mixed-signal integrated circuits design,
3. Integrated power management.

Hanie Ghaedrahmati, PhD Student

Hanie Ghaedrahmati is a visiting PhD researcher at UCD since 18 January, 2016. She is currently pursuing her PhD with Professor Jiajun Zhou at Shanghai Jiaotong University (SJTU), Shanghai, China since September 2014. She received her MSc in Electrical Engineering (Microelectronics) from Sharif University of Technology, Tehran, Iran in 2013, and her BSc in Electrical Engineering (Electronics) from Shahid Chamran University of Ahvaz, Iran in 2011.

Her research interests are:

1. ADCs Design,
2. High Precision, High Speed and Low Power Comparator Design.

Suoping Hu, PhD Student

Suoping Hu has been a PhD student at UCD since July 2016. He received his MSc degree in Electronic Science and Technology (Professor Jiajun Zhou's group) at Shanghai Jiao Tong University, Shanghai, China, in March 2016. He received his BSc degree in Integrated Circuit and Integrated System from Tianjin University, China in July 2013.

His research interests are:

1. Analog and Mixed-Signal IC Design,
2. Transceivers design,
3. Phase locked loops and frequency synthesizers,
4. Analog to Digital Converter.

Vivek Govindaraj, PhD Student

Vivek Govindaraj has been a PhD student at UCD since October 2015. He received his MSc degree in Signal Processing from Nanyang Technological University, Singapore, in 2014. He received his BSc degree in Electronics and Communication from Anna University, India in 2012.

His research interests are:

1. LTE base on localizationy,
2. UMTS base station localization,
3. Receiver designing using USRP devices.

Viet Anh Nguyen, PhD Student

Viet Anh Nguyen has been a PhD student at UCD since September 2017, and in our group since 2016. He received his MSc degree in Electronic and Computer Engineering in 2017 and his BSc degree in Electronic and Communications Engineering in 2016, both from University College Dublin (UCD), Ireland.

His research interests are:

1. Analog and Mixed-Signal Integrated Circuit design,
2. Data converters,
3. Time-mode data conversion and signal processing.

http://www.bogdanst.com/phd-student.html

Yue Chen, PhD Student

Yue Chen has been a PhD student at TU Delft since September 2014. He recieved his MSc and BSc degrees in Electronic Engineering (Micro-Electronics) from Xi´an Jiaotong University, Xi´an, China, in 2014 and 2011 respectively.

Her research interests are:

1. Analog and mixed-signal IC design,
2. Digitally controlled oscillator, especially for low power applications,
3. ADPLL system design.design of LNA, Mixer, VCO, PLL

Mohamed Atef, PhD Student

Mohamed Atef has been a PhD student at UCD since May 2016. He is currently working part-time at Analog Devices in Limerick, Ireland. He received his MSc and BSc degrees in Electrical Engineering from Ain Shams University, Cairo, in 2016 and 2009 respectively. His MSc thesis was about designing of low-noise wide-bandwidth all-digital phase-locked loops (ADPLL) based on noise-shaping time-to-digital converter (TDC). His BSc graduation project was about designing of spread spectrum clock generator for SATA II. He worked as an analog/mixed-signal IC design engineer at MEMS Vision in Cairo, Egypt since 2010.

His research interests are:

1. Analog and Mixed-Signal Circuit Design,
2. All-Digital Phase Locked Loop Frequency Synthesizers,
3. Noise-Shaping Time-to-Digital Converters,
4. RF circuits and systems.

Augusto Ronchini Ximenes, PhD Student

Augusto Ronchini Ximenes has been a PhD student at TU Delft since April 2012. He received his MSc degree in Electrical Engineering at State University of Campinas, Campinas in Brazil in July 2011. He did an internship at Xilinx in Dublin in Fall 2015 working on PLLs.

His research interests are:

1. RF integrated circuits design,
2. Microelectronics,
3. Advanced analog integrated circuit design,
4. Different topologies for LNA, active and passive mixers and power amplifiers, both for low power applications.

Chen Zhao, PhD Student

Chen Zhao has been a PhD student at UCD since September 2016. He received his MSc degree in Integrated Circuits and Systems from Peking University, China, in July 2016. He received his BSc degree in Electronic Science and Technology (Microelectronics Direction) from Southwest Jiaotong University, China, in July 2013.

His research interests are:

1. Mixed-signal Frequency synthesizer,
2. Analog Circuits Design and Application,
3. IC design.

Prathamesh Mukund Khatavkar, PhD Student

Prathamesh Mukund Khatavkar has been a part-time PhD student at UCD since September 2017, currently working at Xilinx in Dublin as a full-time IC designer. He joined UCD as a full-time student in September 2016. He received his MSc degree in Electrical Engineering from Indian Institute of Technology (IIT) Madras, Chennai, India in 2016. He received his BSc degree in Electronics and Telecommunication from Savitribai Phule Pune University, Maharashtra, India in 2012.

His research interests are:

1. IC design for biomedical applications,
2. Energy efficient data converter designs,
3. RF system implementation including the design of LNA, Mixer, VCO, PLL

Ali Esmailiyan, PhD Student

Ali Esmailiyan has been a PhD student at UCD since September 2016. He received his MSc degree in Electrical Engineering from University of Tehran, Tehran, Iran in 2016. He received his BSc degree in Electronics Circuits and Systems from Isfahan University of Technology, Isfahan, Iran in 2013.

His research interests are:

1. Analog and mixed-signal,
2. Data converters integrated circuits,
3. Biosensors and bioelectronics

Umanath R Kamath, PhD Student

Umanath R Kamath has been a part-time PhD student at UCD since September 2015. He works as an analog circuit designer for Xilinx in Dublin. He received his MSc degree in Microelectronics from Delft University of Technology, Netherlands in 2012. He received his BSc degree in Electronics and Communication Engineering from M.S. Ramaiah Institute of Technology, Bangalore, India in 2009.

His research interests are:

1. Time to Digital Converter,
2. DC DC Converter for CMOS Image Sensor,
3. Programmable analog array (PSoC) based system interfaces for sensors.

Ying Wu, PhD Student

Ying Wu has been a PhD student at TU Delft since October 2012. He received his MSc degree in Electrical Engineering from the Department of EIT, Faculty of Engineering, Lund University in Sweden in 2011.

His research interests are:

1. Analog and mixed-signal IC design,
2. Time-to-digital converter (TDC),
3. Digitally controlled oscillator (DCO),
4. Digital/analog PLL, DLL, Frequency synthesis.

Zhirui Zong, PhD Student

Zhirui Zong has been a PhD student at TU Delft since January 2013. Before joining the team, he was an research assistant in RFIC group, Institute of Electromagnetics from University of Electronic Science and Technology of China (UESTC) in Chengdu.

His research interests are:

1. Multiple coupled inductors modeling,
2. CMOS 40 GHz mixer design in a direct down-conversion receiver,
3. Accurate passive modeling in mm-wave regime,
4. Designed a down-conversion mixer using current bleeding techniques in 90 nm CMOS technology.

Milad Piri, Masters Student

Milad Piri is currently a Master student. He has been at UCD since Nov 2016. He received his MScs degree in Microelectronics from Sharif University of Technology, Tehran, Iran in 2015. He received his BSc degree in Electrical Engineering from Shahid Rajee Teacher Training University, Tehran, Iran in 2013.

His research interests are:

1. RF Circuits and Systems,
2. Analog and Mixed-Signal IC Design.

Hesam Khanmohammad, Masters Student

His research interests are:

1. Analog and Mixed-Signal IC Design,
2. Low-power Data Converter Design,
3. Biomedical-specific IC Design,
4. IC Design for Optical and high-speed Communications.

Hesam received his MSc degree in Electrical Engineering (Micro-Electronics) from Sharif University of Technology, Tehran, Iran in 2014. He received his BSc degree in Electrical Engineering (Electronics) from Khaje Nasir Toosi University of Technology, Tehran, Iran in 2012.

PROF. ANDING ZHU'S TEAM

Prof. Anding Zhu

Anding Zhu received the Ph.D. degree in electronic engineering from University College Dublin (UCD) in 2004. He has been working in UCD since 2005, first as a Post-doc, then a Lecturer, an Associate Professor and now he is a Professor in the School of Electrical and Electronic Engineering. His research interests are in the area of nonlinear modelling and characterisation of RF circuits and systems with a particular emphasis on digital linearization of RF power amplifiers for wireless communications. He has published over 100 peer-reviewed papers and received research funding from various sources including awards from Science Foundation Ireland (SFI), European Space Agency (ESA), Enterprise Ireland (EI) and industry donations.

Prof. Zhu collaborates with many universities and international companies. He was appointed as a Guest Research Fellow at University of Aveiro, Portugal in 2006 and worked as a Visiting Scholar at University of California at San Diego (UCSD) in 2007. Prof. Zhu was undertaking a sabbatical leave working as a Visiting Assistant Professor at Stanford University from January to June 2013. He is currently with the RF & Microwave Research Group at UCD and he is the Director of the IoE2 Lab, a multi-disciplinary research laboratory focusing on developing enabling technologies and making scientific breakthroughs for next generation Internet of Things (IoT) and future (5G) communication networks. Prof. Zhu is a Funded Investigator in the SFI Research Centre for Future Networks and Communications - CONNECT, where he is particularly working on physical layer network-aware intelligent radio access nodes in collaboration with Xilinx, Analog Devices, MA-COM and Synopsys.

His current research includes behavioural modelling and digital linearisation of RF power amplifiers, high-frequency non-linear circuit and system simulation, wireless transmitter architectures, RF-DAC, digital signal processing and nonlinear system identification algorithms.

Dr. Reza Nikandish, Post Doc Researcher

Current Research: Integrated Power Amplifiers for 5G Wireless Communications

Research Topics:

- Broadband continuous-mode GaN power amplifiers
- Broadband GaN power amplifier with AM-PM compensation
- Broadband GaN Doherty power amplifier using transformer-based load modulation network
- High efficiency class-F Doherty GaN power amplifier
- Broadband sequential GaN power amplifier
- Reconfigurable class F GaN power amplifier
- Harmonic tuned linearized 3.5-GHz GaN power amplifier

Education:

- Postdoc researcher, University College Dublin, Ireland, 2016 – Present
- Ph.D., Sharif University of Technology, Iran, 2014
- M.Sc., Sharif University of Technology, Iran, 2006
- B.Sc., Chamran University, Iran, 2004

Samaneh Sadeghi Maraht, Post Doc Researcher

Current Research: My research is mainly focused on designing small size antenna with high directivity/gain and wide bandwidth that operates in the frequency of mm wave range (30 GHz-300 GHz).

Research Topics: mm-wave antenna for high speed data transmission

Education: University College Dublin (Current PhD student), 2017-

K.N.Toosi University of technology (MSc), 2015

Guilan University (BSc), 2012

Mr. Brian Keogh, PhD Student

Current Research: Wideband Self Interference Cancellation for 5G Full-Duplex Radio.

Effective Self Interference Cancellation (SiC) is an important consideration for future 5G radio. If it can be successfully implemented, SiC has the potential to double spectral efficiency for certain 5G applications.

Research Topics: Fig. 1 Radio Architecture for Full-Duplex

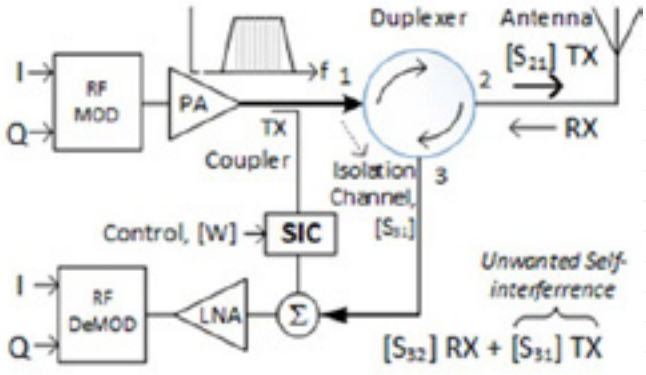
Full-duplex operation is considered difficult to implement because the isolation between the transmit (TX) and receive path (RX) is not perfect. Current solutions take a copy of the TX signal and use this copy to cancel the unwanted self-interference as shown Fig. 1.

The research topics focus on novel methods to extract time delayed copies of the TX signal so that advanced stochastic algorithms can precisely match the frequency domain response of the channel.

Education: BEng (Hons) in Electronic Engineering, MSc in Computer Science.

Lecturer in IT Tallaght, Department of Electronic Engineering.

Current PhD studies are supported by UCD and SFI.



Ms. Yang Xu, PhD Student

Current Research:

- Gallium nitride (GaN) power amplifier design
- Continuous mode power amplifier

Research Topics:

- Power amplifier design for 5G applications
- Monolithic microwave integrated circuit (MMIC) PA realization

Education: B.E. and M.E. degree in Harbin Institute of Technology, Harbin, China.

Currently working towards the Ph.D. degree in the RF & Microwave Research Group at University College Dublin, Dublin, Ireland.

Mr. Yue Li, PhD Student

Current Research:

- Wideband digital predistortion architectures for 5G communications
- Low-complexity behavioral models for linearization of highly nonlinear power amplifiers
- Low-complexity model coefficient extraction methods
- Adaptive digital predistortion for PAs in power-varying operation

Research Topics:

- Behavioral modelling of RF PAs
- Digital predistortion techniques for advanced wireless communication systems
- Digital baseband signal processing

Education:

- Bachelor of Engineering in Information Engineering, Southeast University, China, 2012-2016
- PhD Candidate, University College Dublin, 2016

Ms. Meng Li, PhD Student

Current Research: Doherty power amplifier and GaN monolithic microwave integrated circuit power amplifier design.

Research Topics: High efficiency and wideband power amplifier for 5G wireless communication

Education: B.E. and M.E. degree in electromagnetic and microwave technology from the University of Electronic Science and Technology of China, in 2012 and 2015, respectively. I am currently working toward the PhD degree in the RF & Microwave Research Group at University College Dublin.

DR. BARRY CARDIFF'S TEAM

Dr. Barry Cardiff

Current Research: Digitally-Assisted Analog Design
Embedded systems (mainly for biomedical devices)
Compressed sensing applications – currently focused on cost & power reduction of 5G systems.
Flexible waveforms for future wireless communications
Physical Layer Network coding in relay systems – design and analysis

Education:

- 2011: PhD Electronic Engineering from UCD.
- Thesis Title "Design Techniques for Vector Systems in Communications"
- 1995: M.Eng.Sc in Electronic Engineering from UCD.
- Thesis Title: "Digital Receiver Techniques in Mobile Communications"
- 1992: B.Eng in Electronic Engineering from UCD.

Mr. Armia Salib, PhD Student

Current Research: Digitally-Assisted Analog Design:
We are designing new methods to augment traditional ADCs with digital techniques in order to improve the overall circuit performance. This can result in smaller, cheaper, lower-power parts with equivalent conversion performance (e.g. ENOB), or conversely in high-end applications can allow very high conversion performance targets to be achieved. This work is being conducted in collaboration with local industry.

Research Topics: Digitally-Assisted Analog Design

Education: 2014: M.Sc. in Electrical Engineering, from Ain Shams University, Egypt.
Thesis Title: Digital Calibration for Time Interleaved Analog to Digital Converter

2007: B.Sc. in Communications & Electronics, Alexandria University, Egypt.

DR. BRENDAN MULLANE'S TEAM

Dr. Brendan Mullane

Current Research: My current research involves the development of an optimized signal processor for spectral and linear analysis of on-chip data converters targeting in-situ test and diagnostic applications. Programmable algorithms and hardware techniques are being developed to efficiently perform analysis on-chip without the need for expensive external equipment.

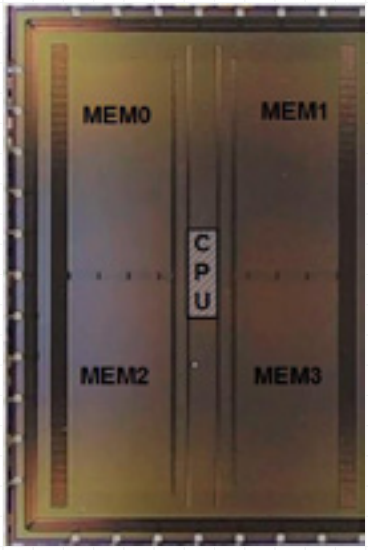
Other supervised research activities include the development of circuit techniques to extend the spectral performance of data converters including dynamic element matching solutions to removed unwanted noise characteristics.

My research looks to assist PhD/ Masters researchers identify advanced performance and low power VLSI solutions.

Research Topics: CPU/DSP, digital assisted IC techniques, ADC Built-in-Self-Test, Energy efficient and intelligent sensing technologies, Brain signal monitoring and application, Safety critical test & diagnostic applications.

Education:

- PhD in Electronic Engineering from University of Limerick
- Masters of Electronic Engineering from University of Limerick
- BEng in Electronic Engineering from University of Limerick



Dr. Vincent O'Brien, Research Staff

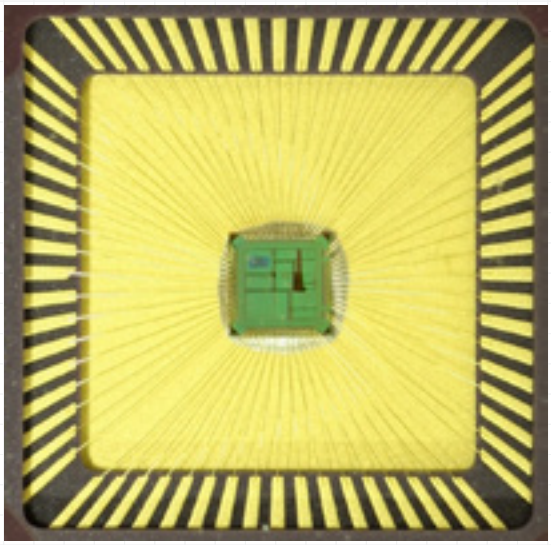
Current Research: My current research activities involve the development of built-in-self-test algorithms and hardware to enable on-chip testing of embedded data converters. My PhD research focused on the design of digital signal processing algorithms to correct digital to analog converter non-linearity in oversampling data converters.

Research Topics: Digitally assisted analog, built-in-self-test, digital signal processing, data converter design

Education: PhD. Electronic Engineering, University of Limerick

MEng. Electronic Engineering, University of Limerick

BSc. Electronic Systems, University of Limerick.



Shantanu Mehta, Research Staff

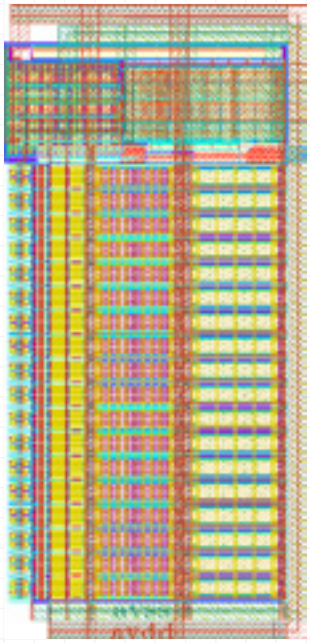
Current Research: My current research is focused on employing an efficient Tri-level Dynamic Element Matching technique in oversampled Tri-level current steering DAC. The aim is to increase the bandwidth of the converter using low power, propagation delay and less area. Final task is to test the manufactured chip and obtain the measurement results.

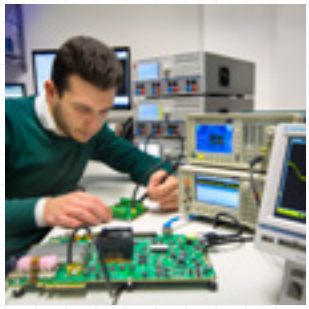
Research Topics:

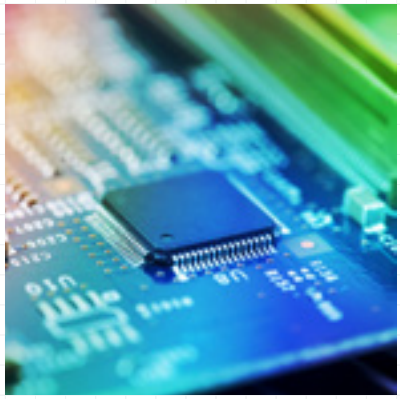
1. High-speed ADC and DAC's.
2. Digital Signal Processing.
3. Sigma Delta ADC and DAC'S.
4. Bi-level and Tri-level Dynamic Element Matching Techniques.

Education:

- Currently pursuing PhD in Microelectronics from University of Limerick, Ireland.
- M. Tech, VLSI Design from Vellore Institute of Technology, India.
- B.E., Electronics & Telecommunications from Walchand Institute of Technology, India.







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