



Kilian O'DONOGHUE

Technology Centre: MCCI, Tyndall National Institute
Academic Mentor: Dr. Padraig Cantillon Murphy
Company Partner: Integer Holdings
Company Mentor: John Hayes

Kilian received B.E. and PhD degrees in electrical and electronic engineering from University College Cork, Cork, Ireland, in 2011 and 2015 respectively. He has over ten years' experience in medical electronic design and has worked in multiple start-up and early stage medical device companies in Ireland and Canada, developing core technologies in robotics, sensing, navigation and medical imaging systems. His research interests include EM tracking systems, circuit design, magnetic field modelling and minimally invasive surgeries.

Dr. Padraig Cantillon Murphy

Pádraig is Professor in Electrical and Electronic Engineering at University College Cork, with over fifteen years of experience in medical device and medical system design. Pádraig previously held research roles at MIT, IHU Strasbourg, Imperial College London, and Harvard Medical School where he developed commercialised technology for minimally invasive surgery. He has co-founded two medical device start-ups and is professor of electrical engineering at University College Cork. His core expertise lies in medical imaging and electromagnetic system design, interventional devices and user-centred design.

John Hayes

Dr. John Hayes is based at the Integer/Brivant International R&D Centre at Tyndall National Institute, Cork, Ireland where he formulates and manages projects developing smart technologies and sensors for integration into Lake Region products. He has over 25 years technical and management experience in the fields of medical devices, sensors, photonics and semiconductors working for companies such as Brivant/Integer, Firecomms, Parthus-CEVA, Andersen Consulting and Accenture. He is a Senior Member of the Institute of Electrical and Electronics Engineers and has published over 30 peer reviewed papers and patents in the areas of photonics, semiconductors and medical devices.

MCCI, Tyndall

MCCI focuses on delivering high impact research for the semiconductor industry. Funded by Enterprise Ireland and the IDA, our role is to generate innovative technologies. They are the single point of contact for the microelectronics industry in Ireland to access academic research. The centre is hosted in Tyndall National Institute in Cork and has an annual research revenue in excess of €8.1 million and a team of over 90 researchers and engineers across Tyndall National Institute, University College Dublin and University of Limerick and collaborating on more than 50 research projects.

Integer

Integer Holdings Corporation is one of the largest medical device outsource (MDO) manufacturers in the world serving the cardiac, neuromodulation, vascular and portable medical markets. The company provides innovative, high-quality technologies and manufacturing to Medical Device OEM's to enhance the lives of patients worldwide.

Wireless Inertial Magnetometers for Surgical Navigation

Electromagnetic tracking (EMT) is the gold-standard for instrument tracking and navigation in the clinical setting without visual line-of-sight. Similar to GPS navigation, the positions of medical instruments are tracked on MRI or CT generated 'maps' of the patient's body without having to rely on X-ray imaging which is harmful to both patient and clinician under continuous use.

Current EMT technology suffers performance degradation in standard medical operating room environments. Metal objects in the vicinity can introduce magnetic distortion errors to the detriment of accurate tracking inside the patient. Furthermore, the most critical minimally invasive interventions require smaller and smaller instruments in applications such as endoluminal surgery where the body's natural structures, such as veins and airways, are used to access surgical sites. As a result, the need for smaller EMT sensors is essential to meet these modern clinical demands.

My aim is to advance EMT technology in the areas of miniaturisation, wireless operation and simpler integration into medical devices with new miniaturised sensors. Using modern silicon fabrication techniques, miniaturisation of EMT sensors will pave the way for integration of these tiny sensors into cutting edge catheter designs. Sensor fusion of existing magnetic sensors and inertial measurement capabilities commonly found in smartphones will be used to mitigate the effects of magnetic distortion of materials. Finally, wireless operation of these combined sensor units will be explored. These sensors will be integrated into catheters developed by Integer and pre-clinical validation of the new devices and will be performed in collaboration with the Institute for Image Guided Surgery (IHU) in Strasbourg, France and the Foundation for Industrial and Technical Research (SINTEF) in Trondheim, Norway with whom our group has strong collaborative links. This research will accelerate the integration of EMT in the clinical setting and improve procedural outcomes for both clinicians and patients alike.

