



Institute of Technology

Ciência sem Fronteiras / Science Without Borders

Postgraduate Project Template

Institution:	Waterford Institute of Technology
Title of Postgraduate Opportunity: (include level of study)	A beam steering computer for a novel continuous phase smart antenna (Level of Study: PhD)
PI Name & Contact Details:	Michael McCarthy and Dr Paul O'Leary Mmccarthy@wit.ie and poleary@wit.ie
Department/School:	Department of Engineering Technology
Research Centre /Group:	Wireless Communications & Large Scale Simulation Group
Research Centre/Group website:	www.wit.ie/research/centres_and_groups/research_groups/engineering/wireless_communications_large_scale_simulation_group
<p>Brief Summary of PI research / research group /centre activity</p> <p>The Wireless Communications & Large Scale Simulation Group is actively involved in wireless research in both hardware and software. We are not a large research group, with 8 members (2 staff and 4 postgraduates), and have conducted research in the areas of wireless propagation/communications and embedded systems. The group is well-equipped, with:</p> <ul style="list-style-type: none"> • Agilent E8267D 20GHz vector signal generator • Agilent DSA91204A 12GHz -4Ch, high-speed Oscilloscope • Rhode & Schwarz ZVB20 - 4-port bi-directional VNA (20 GHz) • Tektronix RSA6100A Series High Performance – 14GHz Real-Time Spectrum Analyzer • Two extensively-equipped LabView controlled PXI racks • We also have broadband horn antennas covering 800MHz-16GHz. • Pentax total station for precise angular measurements, modified for antenna mounting • Tektronix MSO2012 mixed signal analyser • A number of FPGA development boards including a Stratix IV board. • Finally, we also have an anechoic chamber. 	

Brief Description of PhD Project

Recent research carried out at WIT¹ has led to the development of a novel, flexible, low-cost, easy-to-use, smart phased array antenna platform prototype. The prototype is based on quadrature modulators (more conventionally used in modulating communications' carriers), which facilitate continuous rather than the more conventional phase switched radiation patterns, D/A quadrature control converters and low-speed synthesis control. The prototype was put to the test with four simple, low-power patch antenna elements at a 2.4GHz operating frequency. This research will be of benefit in digital beamforming algorithm research, 4G/LTE/MIMO technology or software defined/cognitive radio techniques.

[1] Liu Yao, *Flexible Continuous Controlled Smart Antenna Platform*, WIT Master's thesis 2012.

Keywords: Smart antennas, software defined radio, cognitive radio, beam forming

Motivation: Modern wireless technologies require accurate beam positioning in order to succeed in spatial division multiple access and spatial segmentation.

Project Goal: System prototype including multiple characterised antennas, a firmware beam steering computer implementing an appropriate continuous phase algorithm.

Expected Benefit: The developed solution will lead to the:

1. Development of reproducible low-cost, patch antennas with characterised beams.
2. Enhancement of the existing beam steering computer, using the newly acquired Stratix IV.
3. Formulation and test of innovative smart algorithms that would adaptively track signal sources, based on signal strength and possibly also the expected path.

Key Attributes of Project for Brazilian Postgraduate Students

The equipment available to facilitate this project is listed earlier and includes a wide array of RF and high-speed, time domain equipment. There is considerable experience in our Department of Engineering Technology, with embedded systems, telecommunications engineers and analytical scientists. As well as this, research in our group is also informed by extensive collaboration with industrial and academic groups. This project is a great opportunity for a student to study in the exciting area of smart antennas.

Unique selling points of PhD project in WIT:

WIT has an accredited Masters in Electronic Engineering. Researchers can have access to this course, according to their research needs and/or interests (although this is not a requirement). Our group has completed collaborative projects with Irish industrial partners such as Benetel, Zelinda and Relequa Analytic Systems and has collaborated with other research centres such as TSSG and SEAM, as well as research groups from other third level institutions such as UCC, Ireland, Fachhochschule Hannover, Germany, Blekinge Inst. of Technology, Sweden and the University of Agder, Norway, with publications in conferences hosted by the IEEE, European Wireless conference and the Royal Irish Academy.

Please indicate graduate disciplines which are eligible for application:

Electronic Engineering, Telecommunications

Alignment with Science Without Borders Priority Areas:

Please indicate the specific programme priority area under which the proposed postgraduate project fits – choose only one (tick box)

Engineering and other technological areas	x
Pure and Natural Sciences (e.g. mathematics, physics, chemistry)	
Health and Biomedical Sciences	
Information and Communication Technologies (ICTs)	x
Aerospace	
Pharmaceuticals	
Oil, Gas and Coal	
Renewable Energy	
Minerals	
Biotechnology	
Nanotechnology and New Materials	
Technology of prevention and remediation of natural disasters	
Biodiversity and Bioprospection	
Marine Sciences	
Creative Industry	
New technologies in constructive engineering	