Department	School of Engineering and the Built Environment
Supervisors	Naser Ojaroudi Parchin and Chan Hwang See
Project Title	**MIMO and Phased Array Antenna Systems for 5G/6G Wireless Communications**

PROJECT DESCRIPTION

Due to the limited capacity of the current wireless networks (4G), the future generations of wireless systems (5G/6G) have drawn great interest in both academia and industry to fulfill the promptly growing demands of higher data rates, lower latency, and greater reliability. The 5G network promises significantly increased capacity, massive connectivity, and low latency. It is also expected that 6G will provide much greater coverage, lower costs, and energy consumption. Antennas, as a critical component of wireless communication systems, play an essential role in demonstrating these capabilities. Among them, Multiple-input and multiple-output (MIMO) and phased array antennas with beamforming techniques are promising technologies to obtain the requirements of 5G/6G. They can significantly enhance the capacity of the system and resist multipath fading. To achieve an efficient operation of an antenna system, several challenges such as increased elements, broad/multi-band operation, multi-functionality, and sufficient efficiency/gain levels must be addressed.

The goal of this Ph.D. project is to develop innovative designs of high-performance/multi-functional MIMO and phased array antenna systems for 5G/6G wireless communications. The target frequencies include sub-6 GHz, mm-wave, and THz spectra. The designs will be characterized by system-level simulation tools such as CST and ADS. It will also involve prototyping and laboratory testing for user equipment and base station applications.

Academic qualifications
A first degree (at least a 2.1) ideally in Electrical or Computer Engineering with a good fundamental knowledge of Antennas.

English language requirement
IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:
- Experience of fundamental Antennas and Wireless Propagation.
- Competent in Signal Processing and CAD tools
- Knowledge of Radio Frequency Engineering
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:
Solid experience in RF and antenna systems with a Track record of publishing in high-quality Journals and International Conferences.

Indicative Bibliography	[1] S. A. Ali, M. Wajid, A. Kumar and M. Shah Alam, "Design Challenges and Possible Solutions for 5G SIW MIMO and Phased Array Antennas: A Review," in *IEEE Access*, vol. 10, pp. 88567-88594, 2022.
	[2] W. Hong *et al.*, "The Role of Millimeter-Wave Technologies in 5G/6G Wireless Communications," in *IEEE Journal of Microwaves*, vol. 1, no. 1, pp. 101-122, Jan. 2021.

	[3] Z. Xiao *et al.*, "Antenna Array Enabled Space/Air/Ground Communications and Networking for 6G," in *IEEE Journal on Selected Areas in Communications*, vol. 40, no. 10, pp. 2773-2804, Oct. 2022. [4] N. O. Parchin, J. Zhang, R. A. Abd-Alhameed, G. F. Pedersen and S. Zhang, "A Planar Dual-Polarized Phased Array With Broad Bandwidth and Quasi-Endfire Radiation for 5G Mobile Handsets," in *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 10, pp. 6410-6419, Oct. 2021.
Enquiries	For informal enquiries about this PhD project, please contact Dr Naser Ojaroudi Parchin, n.ojaroudiparchin@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process