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**PhD Studentship:**

**Highly Integrated Active Transmitter Arrays for Future  
Wireless Communications**

**Microwaves and Antenna Engineering Group**

<https://microwaves.site.hw.ac.uk>

## PhD Studentship

In Microwave and Antenna Engineering Group  
Heriot-Watt University, Edinburgh, Scotland, UK, EH14 4AS

### Highly Integrated Active Transmitter Arrays for Future Wireless Communications

#### Project Description:

This PhD-level research will advance the theory and techniques for highly integrated massive transmitter arrays for future wireless communications, both terrestrial and non-terrestrial systems. The ever-increasing demand for higher wireless data transmission capacity calls for higher operation frequency (e.g., millimetre wave) and larger antenna arrays. This in turn requires higher integration in active transmitter arrays in order to reduce the system complexity, cost, and power consumption. The integration will blur the traditional boundary among different radio frequency components, such as antennas, power amplifiers (PAs), beamforming networks, filters, digital pre-distortion (DPD), as well as analogue and digital precoding algorithms.

In this project, the PhD candidate will study each critical radio frequency components in a wireless transmitter, and their non-linear interaction, in order to propose new architecture, hardware, and algorithms for enhanced transmitter and network performance. The demonstration system will then be implemented to validate theory and designed hardware.

The PhD research will involve a number of useful tools:

1. Antenna and other passive radio frequency structure simulation: CST, HFSS
2. Active radio frequency circuits and system level simulation: ADS
3. Algorithm simulation: MATLAB and/or Python
4. System and algorithm implementation: USRP, RFSoc, LABVIEW, Python.

Equipment: Vector Network Analyser, Vector Signal Generator/Analyser, Loadpull Tuner, Arbitrary Waveform Generator, Anechoic Chamber, Software Defined Radio.

**Duration:** 42 Months

**Scholarship:** £18,360 annual stipend plus tuition fees waived

**Deadline:** as soon as possible

#### Supervision Team:

To apply please send your motivation letter, CV, and recommendation letters (optional) to [yuan.ding@hw.ac.uk](mailto:yuan.ding@hw.ac.uk).

Dr Yuan Ding with expertise in Microwave Engineering and Wireless Communications will work with the student on Radio Frequency (RF) subsystem design & wireless communication link optimisation (<https://yding04.wordpress.com/>);

Dr Haijun Fan will guide the student on student on power amplifier (PA) design, characterisation, and linearisation.

#### Candidate:

MSc degree or equivalent in electrical engineering with a focus on RF/microwave engineering, electromagnetics, antenna theory, and communication theory.

Further information on [English language requirements for EU/Overseas applicants](#).

#### Funding Notes:

All students including UK, EU and overseas are eligible to apply for this position covering tuition fees and stipend.

## Relevant References:

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- Kai Xu, Jiayu Hou, Li Wang, Simona Sibio, John Thompson, Steve McLaughlin, Yuan Ding, and Gunnar Peters, "Reconfigurable power divider enabled dynamic hybrid m-MIMO transmitter," *IEEE Open J. Commun. Society*, vol. 3, pp. 2461–2471, 2022. DOI: 10.1109/OJCOMS.2022.3226262
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- H. Barkhordar-Pour, J. G. Lim, M. Almoneer, P. Mitran and S. Boumaiza, "Real-Time FPGA-Based Implementation of Digital Predistorters for Fully Digital MIMO Transmitters," 2023 IEEE/MTT-S International Microwave Symposium - IMS 2023, San Diego, CA, USA, 2023, pp. 263-266, doi: 10.1109/IMS37964.2023.10188033.
- J. G. Lim, H. Barkhordar-Pour, A. B. Ayed, P. Mitran and S. Boumaiza, "On the Viability of Using a Subset of Transmitter-Observation Receivers for Training a Common DPD in Fully Digital MIMO Transmitters," in *IEEE Microwave and Wireless Technology Letters*, vol. 33, no. 6, pp. 907-910, June 2023, doi: 10.1109/LMWT.2023.3268550.
- L. Liu et al., "A Design Approach for Compact Wideband Transformer With Frequency-Dependent Complex Loads and Its Application to Wilkinson Power Divider," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 3, pp. 1611-1624, March 2021, doi: 10.1109/TMTT.2020.3048334.