Reconfigurable Antenna and Systems
Enrico Tolin
Supervisor: Prof.ssa Francesca Vipiana

Research context and motivation
Traditionally wireless systems are designed for single predefined operations. To overcome from limitations due to the standard approach reconfigurable antennas and systems are employed for increase performance and to change the intrinsic characteristic of the antenna to adapt to a pre-determined operative state (frequency, pattern, polarization), achieving better antenna integration and reduce costs.

Addressed research questions/problems
Reduced size and reconfigurable RFID reader patch antenna, based on switchable matching network:
- Frequency agility: one antenna design covers Europe (865-880MHz) and US (902-928 MHz) frequency bands.

Miniaturized and frequency reconfigurable rat-race coupler:
Artificial Transmission Line (ATL) can synthesize lines of any electrical length independently from physical dimensions

Innovative phase management for scan range extension based on Rotman Lens: a reconfigurable phase distribution applied to the Rotman lens double the scan range of an antenna array. It combines two effects involving phase shifters called Complete Beam Shifting and Beam Mirroring.

Submitted and published works

Novel contributions
The reduced size and reconfigurable RFID reader patch antenna, presents a new method to apply the reconfigurability at the matching network to an electrically small patch (0.175 λ x 0.175λ). For changing the linear polarizations (V, H and ±45°), 2 different concepts of reconfigurable feeding network has been designed, employing switchable delay and metamaterials lines. In this way the maximum Polarization Loss Factor is 0.706 dB, with respect to 3 dB given by Circular Polarization approach.

Adopted methodologies
Due to the heterogeneous nature of this topic, different methodologies were exploited for designing the reconfigurable antenna systems. In particular the combination of circuit simulation and EM modeling was the key elements for the design.

Future work
New tunable materials are currently developed (Metal-Insulator-Metal, phase change materials, optically responsive materials), and their reconfigurable property will be applied to bands V (40-75 GHz) and W (75-110 GHz).

List of attended classes
- BMIIRV – Tecniche numeriche avanzate per l'analisi ed il progetto di antenne (26/5/2017, 4 credits)
- 10QFRV – Tecniche innovative per l'automazione (19/6/2017, 4 credits)
- 09QFRV – Protonia: a key enabling technology for engineering applications (11/9/2017, 5 credits)
- 09CRTVR – Il colore di responsabilità nella ricerca e nell’innovazione - l’impatto sulla resilienza sociale (24/5/2017, 4 credits)
- 10QFRV – il colore di responsabilità nella ricerca e nell’innovazione - il ruolo dell’ICT nell’era dell’internet delle cose (23/5/2017, 4 credits)
- 2QFRV – BIOCOMOS interfaces and co-design (19/10/2017, 3 credits)
- 09FRPV – Elettronica digitale e Rete elettr. (11/9/2017, 4 credits)
- 09QFRV – Elettronica digitale e Rete elettr. (11/9/2017, 4 credits)
- 09QFRV – Proietto management (26/5/2017, 1 credit)
- 09QFRV – Public speaking (14/7/2017, 1 credit)
- 09QFRV – Communication (12/7/2017, 1 credit)
- 09QFRV – The new Internet Society: defining the future of digital innovations (17/7/2019, 1 credit)
- ESA Course – RADAR 2003: FUTURE RADAR SYSTEMS (7/6/2019) 3 ECTS credits
- ESA Course – Antenna Systems for 5G Communication (23/5/2019, 3 ECTS credits)