The focus of the research project are a new concepts of microwave filters, phasers and multi-functional and reconfigurable passive components for use in future RF wireless communication systems.

The high frequency passive components are of interest in emerging RF chains to be used in novel communications and radar systems, and Internet of Thing (IoT) sensors for human-centered wireless scenarios. Those components play a key role to enable high efficiency of the system, for example to maximize the data rate available in communication channel. Microwave filters allow one to separate the systems that operate on neighboring frequency bands and limit the interference between those systems. Phasers are the elements of real-time analog signal processing (ASP), that is an alternative to digital signal processing (DSP) techniques and allows for manipulating the signal directly in time domain with low cost and low energy. Phasors can operate in broad frequency range and have potential application in future high frequency electronic systems, but to process the signal a techniques to realize the arbitrary, user defined group delay characteristics are needed. Finally, multi-functional and reconfigurable, tunable components have been developed for performing more-efficient RF-analog-processing multi-actions with spectral agility towards their use in highly-versatile RF front ends. Whereas frequency reconfiguration will be essential in future RF systems, benefits of the multi-functional philosophy are also manifold as follows: (i) higher physical compactness, (ii) power-insertion-loss reduction due to the avoidance of inter-connecting RF interfaces between the mono-functional blocks, and (iii) enhanced electrical performance.

The aim of this work is to develop a new theory of operation and effective design algorithms for new classes of aforementioned passive components and finally use them to design, realize and measure microwave passive components with improved electrical performance.

A key idea that enables us to develop a new classes of passive components is to realize them as coupled-resonator networks that exploit new coupling schemes and frequency dependent couplings. In this project we aim to use frequency dependent of higher orders - quadratic or even nonlinear function of frequency. Finding suitable solutions within this project will enable us to go beyond the state-of-the art of microwave coupled-cavity filter and phaser design.