Reconfigurable Transmitter Amplifiers for Next-Generation Spectrally Sensitive Adaptive Radar

Charles Baylis*(1), Robert J. Marks II(1), Abbas Semnani(2), Dimitrios Peroulis(2), Ed Viveiros(3), Lawrence Cohen(4)
(1) Wireless and Microwave Circuits and Systems Program, Department of Electrical & Computer Engineering, Baylor University, Waco, TX, USA
(2) Purdue University, West Lafayette, IN, USA
(3) Army Research Laboratory, Adelphi, MD, USA
(4) Naval Research Laboratory, Washington, DC, USA

Next-generation radars will need to be adaptive and reconfigurable to meet next-generation spectrum needs. Dynamic spectrum allocation is needed in congested environments to more effectively share spectrum between radar and communications. Radar transmitters will need to be able to adapt to their surroundings and reconfigure their operation based on changing spectral requirements.

This presentation discusses fast reconfiguration algorithms for radar transmitters and the implementation of tunable matching networks capable of fast reconfiguration and power handling levels sufficient to perform radar operations. Algorithms for optimizing the load impedance presented to a power-amplifier device are discussed. In addition, multiple-parameter optimizations are described that allow real-time, joint optimization of the amplifier load impedance with input power or bias voltage. In addition, joint optimization of the circuit with the waveform is examined. The goals of such optimizations include (1) desired range/Doppler resolution characteristics (as manifested by the radar ambiguity function), (2) high power-added efficiency (PAE), and (3) compliance with spectral mask constraints.

To implement real-time reconfigurable radar transmitter amplifiers, reconfigurable impedance tuners are needed that can handle powers in the tens to hundreds of Watts. New tuner developments are discussed that provide promise for high power handling and fast reconfiguration.

A way forward for the design of the next-generation adaptive radar transmitter is discussed, including the integration of the reconfigurable power amplifier and matching network into a software-defined radio platform. The next-generation system will collaborate with its surroundings, dynamically selecting its operating frequency and spectral mask to avoid interference with and from other devices. Collaboration with other devices through ad-hoc networking and the internet-of-things is discussed.