Fast Reconfiguration of Second-Generation Tunable Evanescent-Mode Cavity Matching Network for Frequency Agility in S-Band Cognitive Radar Applications

Jose A. Alcala-Medel*[(1)], Caleb Calabrese[(1)], Charles Baylis[(1)], Anthony Martone[(2)], Kyle Gallagher[(2)], Ed Viveiros[(2)], Abbas Semnani[(3)], Dimitrios Peroulis[(3)]
[(1)]Baylor University, Waco, TX 76798
[(2)]Army Research Laboratory, Adelphi, MD 20783
[(3)]Purdue University, West Lafayette, IN 47907

The issue of diminishing wireless radio spectrum has given rise to the discussion of spectrum sharing with the use of tunable, cognitive radar transmitters. Within the S-band radar spectrum of the United States, future radar systems will be required to share spectrum with wireless communication systems. Radar transmitters must become reconfigurable and be able to sense, predict, and transmit in available spectrum with co-located wireless communication. The development of these next-generation transmitters calls for new tunable load matching networks that combine novel and traditional tuning elements in order to replace traditional wideband amplifiers. These tunable networks offer a solution to the limitations of the finite gain-bandwidth product of traditional wideband amplifiers. In this presentation, we discuss the fast tuning of a 90 W evanescent-mode cavity tuner to different frequencies within the radar S band allocation. Previous work from our group has demonstrated fast tuning of the first-generation version of this circuit, however the second generation tuner we show in this presentation has improved stability and decreased tuning time compared to the first-generation tuner.

The presentation details the characterization, testing, and measurements of a real-time reconfiguration performed on a tunable matching network. A tunable matching network, the "M3-Linear Actuator Based Impedance Tuner," with 25 million possible impedance values, is analyzed thoroughly across multiple frequencies for several impedance states. The device uses two M3-L linear actuators to change the distance between two copper pads and the signal conductor. Changing this distance causes a change in the impedance seen at the input and output of the device. A fast, gradient-based, search is employed to find the optimum tuner setting (impedance) providing maximum power-added efficiency while remaining within spectral mask constraints each and every time the device is tuned to a new frequency.

In many radar scenarios, the radar optimizes range resolution by to using as much transmission bandwidth as possible. Because the tunable matching network is narrowband, this can cause a decrease in efficiency for wider-bandwidth operation. The uses of the tuner for wider-band and variable-bandwidth scenarios in cognitive radar applications are discussed, and the approaches for optimizing the matching networks are also examined for such situations.