Software Defined, Spectrally Sensitive Radar Transmission

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The crowded wireless radio spectrum will require future radar transmitters to be spectrally sensitive. In the United States S-band radar allocation, additional frequencies are being re-allocated for sharing with wireless communications. For example, recent discussion has focused on allocating the entire range from 3.45 GHz to 3.65 GHz for spectrum sharing. As such, radar transmitters must be capable of changing operating frequencies in real time to share spectral bands with co-located wireless communication devices. This requires *adaptive* and *reconfigurable* power amplifiers that can both adaptively alter frequency based on spectral surroundings, under control of a software-defined radio platform, and reconfigure quickly at this new frequency to maintain the operating power and efficiency needed to sustain high-resolution radar operation.

This presentation overviews the construction of such an adaptive and reconfigurable system. The system is able to adapt to actively share spectrum with wireless communications. A 90 W evanescent-mode cavity tuner is used as a tunable load matching network for the power-amplifier device. The entire optimization control is relegated to a software-defined radio controller, which performs measurements of the amplifier output spectrum and assesses the efficiency and spectral performance of the amplifier, and then uses these parameters in a search algorithm to adjust the amplifier's impedance tuner. When the radar transmitter is allocated to a different operating frequency (as in spectral prediction approaches under development), the positions of tunable piezo discs constructed on top of the tuner's cavities are adjusted under control of a modified gradient search algorithm to maximize the power-added efficiency (PAE) while maintaining spectral mask compliance. The tuner optimization can complete within a few seconds, and the time is even shorter with the utilization of a look-up table.

Progress toward integrating the tunable amplifier into a real-time system using spectral prediction and optimization approaches is discussed. Scenarios are examined where an interferer moves about in frequency, and the radar adapts to avoid the interferer. Challenges of integrating the mechanical movement of the tuner with the timing of the decision-making processes are discussed, and the research way forward is overviewed.