Real-Time Multi-Variable Amplifier Optimization Using a Nonlinear Tunable Varactor Matching Network in the Power Smith Tube

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Due to the increasing demand on the wireless spectrum, adaptive and reconfigurable radar transmitters are called for to perform high-resolution detection while meeting spectral constraints and avoiding interference with other devices. Dynamic spectrum allocation is one of the proposed solutions for effectively sharing the radio spectrum. The use of dynamic spectrum allocation implies that future radars will have to reconfigure to adjust both operating frequency and spectral output.in real-time.

This presentation demonstrates fast simultaneous optimization of load impedance and input power in a tunable-varactor network to maximize power-added efficiency (PAE) while meeting constraints on the spectrum quantified by the adjacent-channel power ratio (ACPR). A vector-based modified gradient algorithm implemented in the Power Smith Tube, which is a 3-dimensional extension of the Smith Chart, allows simultaneous visualization of variations in device performance against both reflection coefficient and input power is illustrated. To allow optimization, characterization measurements, to map different combinations of varactor control voltages to load reflection coefficient, are required. Due to nonlinearities of the varactors, the reflection coefficient of the varactor network varies significantly with the power input to the network from the device output. To compensate for the nonlinearities, a power-dependent characterization, which permits characterization at different power inputs to the varactor networks, is necessary. While previously demonstrated in an optimization of only load reflection coefficient, the power-dependent characterization concept is extended to application in the Power Smith Tube where input and output power from the transistor are frequently changed during the course of the search. The power-dependent characterization significantly extends the power range over which the varactor tuner can be used.

Despite the nonlinearities of the varactor tuner; measurement results presented are consistent and illustrate success in simultaneous optimization of input power and load reflection coefficient. As compared to a traditional bench-top tuner, the varactor network shows a substantial improvement in time per measurement, suggesting an improved capability of this technology for future integration into a real-time reconfigurable radar.