3D Fast PAE Optimization Using an Evanescent-Mode Cavity Tuner

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Next generation cognitive radar systems will need high-power matching circuitry with optimization techniques to tune the system. Tunable matching networks have been demonstrated for "on-the-fly" tuning of communication networks, however current tunable matching networks do not have the power handling capability needed for a high-power radar system. This presentation demonstrates a fast PAE optimization algorithm using an evanescent-mode cavity tuner.

The evanescent-mode cavity tuner changes the load reflection coefficient, Γ_L, presented to the amplifier by tuning the resonant frequency of two cylindrical cavities. The resonant frequency of each cavity can be changed by raising and lowering the height of each cavity with its piezoelectric disc. The tuner is also capable of handling up to 90W of power.

The optimization searches a three-dimensional space using a modified interval halving technique to find the best load PAE. The first two dimensions in the search space are the two resonant frequency numbers which determine the Γ_L presented to the amplifier. The third dimension is input power to the amplifier. The search begins by choosing a candidate point and a neighboring point which has a slightly greater magnitude in one dimension than the candidate. The PAE of both the candidate and neighbor is measured. If the neighbor has higher PAE than the candidate, then the next candidate is chosen at the midpoint between the current candidate and the maximum of the range. If the neighbor has a lower PAE than the candidate, then the next candidate is chosen at the midpoint between the current candidate and the minimum of the range. This process repeats for each resonant frequency number and for the input power iteratively until the optimum operating point is determined.

This search has been successfully demonstrated on the bench with a Skyworks packaged amplifier. The maximum PAE achieved by the interval halving search was compared to the maximum PAE determined by traditional load pulls at each input power level in the search space. The search algorithm consistently arrived at a maximum PAE within 1% of the maximum PAE determined from the traditional load pull methods while taking significantly fewer measurements. The optimization algorithm was shown to quickly tune to the best input power and Γ_L using the evanescent-mode cavity tuner.