A Technique of Neural Network Multiobjective Optimization for Efficient Trade-Off between Antenna Return Loss & Radiation Pattern

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This paper outlines a new efficient algorithm of neural network optimization for viable CAD of complex antenna structures. The input impedance (return loss) and radiation pattern are optimazed with respect to the same design variables with a decomposed radial basis function (RBF) neural network capable of dealing with various antennas accessible for 3D FDTD analysis. The algorithm features the dynamic generation of as much FDTD data as the network needs to find a solution satisfying the constraints; FDTD analysis is performed by *QuickWave-3D*. The performance of the optimization technique is illustrated by its application to three systems: a lens antenna constructed as an open-end circular waveguide inserted into a dielectric sphere, a rectangular-ring planar antenna, and a dielectric resonator antenna (DRA). It is demonstrated that in comparison with two conventional techniques capable of multiobjective optimization the proposed procedure finds “better” solution and requires fewer number of FDTD analyses.

For example, in Fig. 1, there are shown the optimal return loss (RL) curves and radiation patterns (RP) found for the DRA by each optimization algorithm tested. The goal was to find two resonances, one at 1.6 GHz and one at 2.45 GHz, and to maximize every component of the RPs at the two resonances. This yields 10 objectives. It is seen that both the RBF-ANN method and the MATLAB optimization algorithm were able to find the two resonances, and the RBF-ANN found arguably better RPs. The RBF-ANN optimization took 750 simulations while both *QW-Optimizer+* and the MATLAB optimization algorithm were stopped after reaching the limiting number of FDTD simulations (1000).

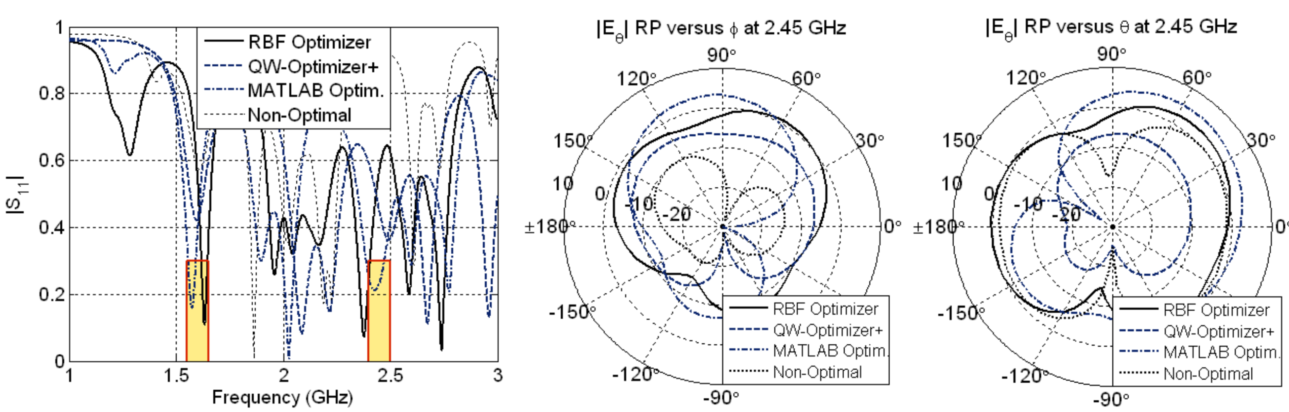

Fig. 1. The optimal RL (left) and RP (right two) of the DRA. The optimality zones are shown in red boxes; the goal of the RP optimization was to produce omni-directional characteristics.