BROADBAND LOSSY IMPEDANCE MATCHING OF ANTENNAS

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In RF applications such as transmitters, amplifiers, receivers, and antennas, a task of vital importance is the design of an impedance matching network, one that can transfer the most power from the source to the load. Lossless matching networks at a single frequency have been well studied, while the broadband impedance matching problem was only defined 70 years ago.

This paper provides a background of the theory basis and design approaches in the history of broadband impedance matching. Lossless impedance matching optimization using the MATLAB Global Optimization Toolbox is discussed, and an approach combining brute-force techniques and the Real Frequency Technique is proposed. The bandwidth of a candidate high-frequency (HF) dipole antenna has been increased from 3.4% to at least 14.4% after the optimization, with a Voltage Standing Wave Ratio (VSWR) of 2:1.

In order to match the source and load over a wide band, a tradeoff is forced between the antenna gain and its bandwidth. The lossy impedance matching problem is investigated in this presentation as a multi-objective optimization problem. Multiple optimization algorithms are used to find the Pareto front for a given lossy network topology, with the solution limit given by the H-infinity theory.

The presentation also includes performing lossless and lossy impedance matching optimization using results from more numerical platforms like FEKO and GNEC for various antenna configurations. More topologies are also explored including topologies with more elements and those including the insertion of lossy components into the lossless networks. Additionally, the presentation also looks into the latest nature-inspired optimization algorithms as applied to the lossy impedance matching problem and compared with the traditional algorithms. The approach with the best performance discovered in this work is applied to conformal antennas of great interest such as the low-profile bow-tie antenna close to a ground plane and compared with the new approach of using metamaterials inserted between the antenna and the ground plane.