Comparison of the bandwidth potential and Q value techniques for estimating antenna bandwidth

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INTRODUCTION

In general, it is difficult to compare different antennas in terms of their bandwidth because the antennas could be differently matched (overcoupled vs. undercoupled) or not matched at all. This paper present two techniques that can be used to compare differently matched antennas. These tools can be used in the antenna concept creation phase to select the best antenna candidate that can be later tuned to resonance by modifying the structure or by using a matching circuit.

The Q value technique [1] is based on estimation of the antenna Q value directly from the impedance data. The technique implicitly uses a series reactive component to make the total reactance zero at the analysis frequency. The Q value estimate can be calculated from a simple formula that also includes the derivative of the input impedance.

In the bandwidth potential technique (see e.g. [2]), a two-component matching circuit for conjugate matching is constructed at each analysis frequency and the symmetric bandwidth through the matching circuit is recorded. In the optimized bandwidth potential the symmetric bandwidth is optimized for each analysis frequency.

RESULTS

When the antenna is narrowband (or the obtainable bandwidth through a matching circuit is narrow) the Q value and bandwidth potential approaches give very similar results. Also the optimized bandwidth potential results are quite close to the unoptimized results. However, when the antenna becomes more wideband and especially if a double resonance appears, the Q value technique does not any longer produce reliable results as it was derived using the single resonance assumption. Also the difference between the optimized and unoptimized bandwidth potential can be quite large when a double resonance appears.

In addition, if there is measurement noise or simulation artifacts in the impedance data the Q value may produce erratic results because it uses the derivative of the impedance in the estimation. Therefore, the bandwidth potential technique offers a more reliable method for estimating the obtainable bandwidth.

REFERENCES

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