An overview of stored-energy based methods to estimate the best bandwidth for electrically small antennas

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1 Extended Abstract

In this paper and talk we investigate stored energy based methods to obtain an estimate on the best impedance bandwidth of antennas that are electrically small. This bandwidth has been shown in [1] to be closely related to the impedance based Q-factor, Q_Z, for $Q_Z \sim 5$ or larger. It is also known that the stored energy based Q-factor, Q_W is for most small antennas closely related to Q_Z [2].

Bounds on Q-factors date back to Chu in 1948 for spheres, but have recently been derived for arbitrarily shaped antennas. Initial considerations were limited to determine the ratio of partial directivity over Q_W, [4], but has since then been extended to determine bounds for Q_W itself see [3] for an overview. Both for free standing antennas and for device embedded antennas. Recently we have extended bounds on Q-factors under a range of different types of constraints, like superdirectivity [5], power front-to-back ratio and far-field shaping [6].

To determine bounds on the Q-factor, we need to phrase the situation for which these bounds are valid rather carefully. These bounds are determined prior to the antenna design, the key required information is in which volume the antenna will be designed within. Thus given a desired antenna volume, we can determine the best possible Q_W-factor which thus gives us an estimate on the best possible impedance bandwidth. Since Q_W is determined prior to the antenna design, it cannot utilize the input impedance or other antenna features in determining Q_W. It is a remarkable fact, that bounds on Q_W accurately predicts the impedance bandwidth of well designs antennas. We also review in this talk approaches to determine the stored energy under different constraints and the advantages and disadvantages of the methods.

References

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