A Lower Bound of Antenna Efficiency Based on the Two-Port Model: How Close is it?

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The passive, unknown two-port antenna model that has been recently developed is used to investigate the loss and mismatch characteristics of an antenna. Previous work has shown that the two-port antenna model can be used to determine a lower bound of the antenna's transmitting efficiency with data taken from a single antenna in a reverberation chamber. The limit of this calculation is that it relies on assumptions made in the two-port antenna model and provides only a lower bound of the antenna's efficiency. One of the necessary assumptions is that the stirrer in the reverberation chamber is perfectly reflecting for at least a few positions.

Here we evaluate how close the calculated lower bound is to the real antenna efficiency using a simple and well-constructed monopole antenna of known size and conductivity. The ohmic losses of the monopole can readily be calculated analytically thus providing a known antenna radiation efficiency. The monopole antenna can then be placed inside a reverberation chamber, measured, and evaluated with the two-port antenna model. We show numerical antenna efficiency calculations and corresponding measurement data from 500 MHz to 2 GHz. This large frequency band also allows for an evaluation of the model at higher frequencies where the two-port antenna model is thought to perform poorly. This poor performance is due to the deterioration of the perfectly reflecting stirrer assumption. The data are analyzed to gain a better understanding of how low the lower bound calculation is when compared to the analytical answer, and how a less than perfectly reflecting paddle impacts the efficiency calculation.