TIME DOMAIN STUDIES OF TRANS-RECEIVE ANTENNA SYSTEM THROUGH THE ESTIMATION OF COMPLEX ANTENNA FACTOR

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Abstract:

This paper presents the time-domain studies of a complete transmit-receive antenna system dealing with shorter pulses with ultrawideband bandwidths. Because of the broad frequency band of the short-pulsed fields, the knowledge of the wide-band performance of transmit and receive antenna, both in amplitude and phase is essential for the evaluation of an UWB antenna in time domain. The commonly used transmit and receive antennas are different types of wire antennas. The loaded wire antennas (e.g. inverted L, T, I and C-shaped antennas) in transmitting mode are widely used for low frequency communication. Recent studies show that these antennas can be used as Electromagnetic Interference sensor without any major compromise in the performance in terms of the cross-polarization isolation [1]. The most common performance descriptor of an EMI sensor is the Antenna Factor. The ratio of the incident electric field at the surface of the receiving antenna to the received voltage at the antenna terminal when terminated in 50 ohms load is known as the Antenna Factor [2]. However, for an UWB antenna, the concept of the Complex Antenna Factor (CAF) is used. The CAF, as defined by Ishigami, Iwasaki, et al, adds phase information to the conventional scalar Antenna Factor [3]. Works had been started on the evaluation of CAF of loaded antennas [4]. But not much effort has been made on the time domain studies of a complete transmit-receive system using these reduced-sized loaded antennas. In this paper, a Method of Moment-based numerical technique with pulse basis function and point matching has been used to determine the current distribution on the antenna for an incident wideband signal and hence the CAF of these antennas in the frequency domain. The CAF versus frequency data is used to achieve the voltage transfer function relating the receive antenna load voltage to the generator voltage at the transmit antenna, which is further used to achieve the transmit / receive voltage waveform in time domain. Ideally the transmitted and received waveforms should be identical to the input waveform, though the frequency characteristics of practical transmit and receive antennas invariably distort the shape of the waveforms. Solutions for various optimizations of transient waveforms and signals used in ultrawideband radio systems were presented by D. M. Pozar [5]. Here the transmit antenna generator waveform required to maximize receive antenna voltage amplitude (with bounded input energy), as reported by Pozar has been used. The very good matching of the theoretical results with the reported data [5] proves the validation of

the theory. Studies show that using this technique it has been possible to optimize the voltage excitation, which is found to work efficiently for reduced-sized trans-receive loaded antennas.

References

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