

Antennas in the Time-Domain: the scattering dyad

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Transmission and reception of time dependent [or time-domain (TD)] ultra-wideband (UWB)/short pulsed (SP) signals has gained interest in recent years due to their advantage over time harmonic signals (TH) in a wide range of applications such, for example, communication, radar and remote sensing, etc. The traditional approach to deal with antennas for TD or UWB/SP signals is on a frequency-by-frequency basis within the frequency-domain framework of the TH antennas in conjunction with the time-to-frequency and frequency-to-time Fourier transforms. An alternative approach is to deal with such antennas within a complete TD framework as in (A. Shlivinski, E. Heyman and R. Kastner, "Antenna characterization in the time domain" IEEE Trans. Antennas and Propagation, Vol. 45, no. 7, (July), pp. 1140-1149, 1997) by defining a transient transmitting and receiving effective heights of an antenna as a measure of its capability to transmit/receive plane-waves in far-field scattering-free scenarios. In modern closely packed scenarios, however, antennas are usually embedded in environments where their self-scattering should also be considered. This talk considers this issue.

In this talk some transient scattering characteristics of an antenna will be discussed and demonstrated for antennas in closely packed environment. To that end, a review of known TD or UWB/SP characteristics of an antenna will be given as a starting point for the introduction of the TD properties of the "antenna as a loaded scatterer". Using the antenna's TD scattering parameters (the scattering properties of the antenna for an incoming wave-field, the effective heights of the antenna in transmission and reception, and the terminal voltage-wave reflection coefficient) leads to some general identities relating TD self-scattering characteristics of antennas with different terminal loading. These TD characterizing parameters are derived for plane-waves in far-field scenarios, where they can be used, next, for the near/intermediate zone TD parameterization of the fields radiated, scattered and received by the antenna. An application of this parameterization is, for example, in the analysis and synthesis of the transient properties of an antenna array. These issues will be presented on a theoretical basis where they will serve as the background for further analysis of antennas in a densely packed environment.