

On the Use of Log-Periodic Antennas in Pulsed Ultra-wide Band Communication Links

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Log-periodic antennas belong to the class of frequency independent antennas and are thus able to achieve multi-decade wideband performance with consistent impedance and radiation pattern. The review of open literature shows that the application and use of log-periodic antennas for pulsed ultra wideband (UWB) applications is limited by their inherent dispersive characteristics. Despite their attractive broadband frequency-domain operation, log-periodic antennas can severely distort short pulses transmitted and received by impulse radio ultra wideband systems (IR-UWB). Since the radiation of log-periodic antennas occurs from different positions on the antenna at different time the frequency dispersion is intrinsic to these antennas which translate to pulse distortion in time-domain.

This paper establishes a framework for joint frequency and time domain characterization of planar log-periodic in UWB communication systems. Specifically, the dispersion of bi-directional planar log-periodic antennas is evaluated first computationally in terms of the radiation transfer function, group delay, and fidelity factor. The fidelity factor which represents the maximum cross correlation between transmitted and radiated pulses is used to characterize the antenna's time-domain performance over the full field of view. The effects of the antennas' geometrical parameters on the time- and frequency- domain performances are discussed and relevant conclusions regarding a low-dispersion log-periodic antenna with acceptable frequency-domain performance are presented. Finally, a pre-distortion compensation technique based on an analytical group-delay model is introduced to enhance their time-domain signature. Computational results are supported with the measurements of a decade wideband planar log-periodic antenna. The demonstrated frequency- and time-domain bi-directional operation of the proposed log-periodic antenna makes it appealing candidate for the use in indoor UWB communication systems.