MITIGATING THE TRANSIENT CHIRP OF CONICAL LOG-SPIRAL ANTENNAS

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When an ultra-wideband pulse antenna is required, the conical log-spiral antenna is often considered at first because of its low-profile and frequency independent nature. However, it suffers from a strong chirp in time. Based on simulation, Thorsten W. Hertel, et al, [IEEE Transactions on antennas and propagation, Vol. 51, pp. 1426-1433, Jul. 2003] showed that the chirp can be removed by using an up-chirp input signal. However, if we need a very short-time pulse to cover ultra wideband, we need to be able to generate the incident pulse with a pulse duration of several nano seconds, which is not very feasible with contemporary technology. In this research, we propose the alternative methods to mitigate the chirp, though introducing other trade-offs.

For conical log-spiral antennas fed at the apex, the radiating signal travels backward along the structure from the apex to be radiated in the reverse direction toward the apex. The dispersion may be lowered if we reduce the height of conical structure or wrap the metal pattern more quickly with the same minimum and maximum diameters of the conical log-spiral antenna. In order to demonstrate this concept, we fabricated several sets of test antennas with the operational range of 3 - 9 GHz, different wrap rate of the arms, and different heights. In addition, a resistive-loaded case was also considered to lower the ringing phenomenon. Antenna tests were performed using two identical antennas with an HP 8510 network analyzer in the frequency-domain. Time-domain results were obtained by an inverse Fourier transform. The antennas were oriented in a co-polarized manner and separated by 101.6 cm (40") distance to be in the far field. The equivalent transient source is a Gaussian with a 50 pico second pulse width, corresponding to a 20 GHz frequency spectrum.

Experimental results showed that a conical log-spiral antenna with a fast rate of wrap has a significant reduction in chirp. The detail results will be presented and compared in terms of antenna input impedance, gain, radiation pattern, and impulse response. The results will also be compared in the time domain to other classic UWB antennas.

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