# Comprehensive Study of Near-field Time-domain Channel Impulse Response for UWB Antenna Systems in Free-space

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UWB Systems have emerged as a crucial technology for Cognitive Radios and 5G Internet-of-Things (IoT) applications. UWB-MIMO systems involving multiple UWB transmitters and receivers are also becoming important for enhancing the channel capacity further. UWB antennas based on time-domain pulse-excitations are generally used in short-range communication systems. However, to compute the impulse response of a UWB transmit-receive (Tx-Rx) system, the relative spacing is generally kept at certain multiples of the wavelength corresponding to minimum impedance-matching frequency of the antenna, thereby ensuring radiating far-field condition. But due to the possible application of UWB antennas in ultra-dense device configurations with very little scope of far-field placement, it is essential to critically assess the transfer function characteristics and transmitted pulse features for radiating and reactive near-field distances between UWB antennas as well.

The present study aims at unfolding certain pertinent characteristics of Channel Impulse response of UWB antenna systems in terms of its near field dependence. The two-fold objective of the work is as follows i) To investigate how or whether the pulse-shape of the impulse response varies with the distance between UWB antennas in a transmit-receive (Tx and Rx) mode and the relative orientation (side-by-side or face-to-face) between the UWB antennas. A concrete guideline on choosing the optimal distance in terms of impedance matching frequencies can be formulated. ii) To study the effect of antenna far-field directivity reflected in near-field impulse response. The simulation and numerical computations tools used for the study are FIT-based CST, as well as MoM-based MATLAB Antenna toolbox. An initial study of near field and far field impulse response is depicted in Fig.1 with the aid of two disc-shaped monopole type antennas each having a radius of 22mm and fitted to a ground plane of dimension 60mm×40mm.
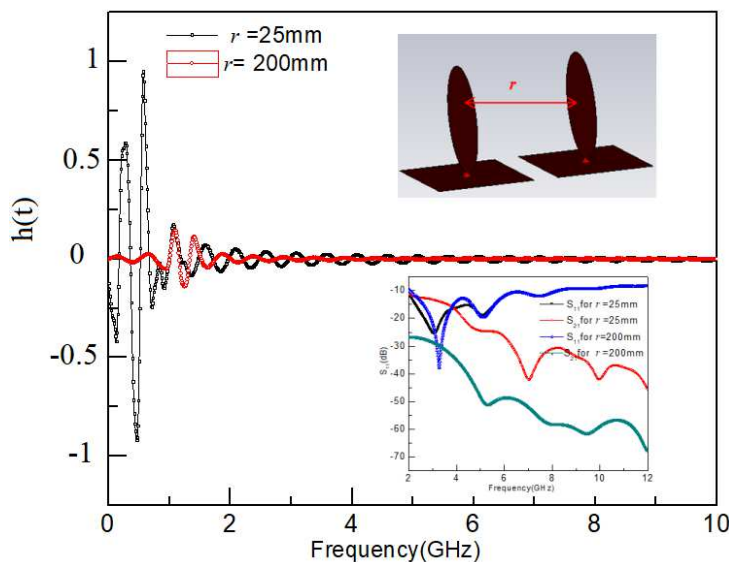


Fig.1: Impulse response of an UWB Tx-Rx system for near field and far field scenarios

# References

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