

The Feasibility and Usability of Antennas Silence Zone for Localization and Path Finding

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Abstract : Antennas are important components that enable transmitting and receiving signals in mid-air (wireless). The radiation pattern of omni-directional (i.e., dipole) antennas, reflects the variation of power radiated by an antenna as a function of direction when transmitting. As the performance of the antenna is the same in transmitting and receiving, it also reflects the sensitivity of the antenna in different directions when receiving. The main observation when dealing with omni-directional antennas, regardless the application, is they equally radiate power in all directions in reference to Equivalent Isotropically Radiated Power (EIRP). Disseminating radio frequency signals in an omni-directional manner form a doughnut-shape-field with a cone in the middle of the elevation plane (when mounted vertically). In this paper, we investigate the existence of this physical phenomena namely silence cone zone (the zone where radiated power is nulled). First, we overview antenna types and properties that have the major impact on the shape of the electromagnetic field. Then we model various off the shelf dipoles in Matlab based on antennas' features (dimensions, gain, operating frequency, ... etc.) and compare the resulting radiation patterns. After that, we validate the existence of the null zone in Omni-directional antennas by conducting experiments and generating waveforms (using USRP1 and USRP2) at various frequencies using different types of antennas and gains in indoor/outdoor. We capture the generated waveforms around antennas' null zone in the reactive, near, and far field with a spectrum analyzer mounted on a drone, using various off the shelf antennas. We analyze the captured signals in RF-Explorer and plot the impact on received power and signal amplitude inside and around the null zone. Finally, it is concluded from evaluation and measurements the existence of null zones in Omni-directional antennas which we plan on extending this work in the near future to investigate the usability of the null zone for various applications such as localization and path finding.

Keywords : antennas, amplitude, field regions, frequency, FSPL, omni-directional, radiation pattern, RSSI, silence zone cone

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