Near Field Radiation Exposure Calculations from ill-defined Antenna Structures

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Abstract: Increasing RF infrastructure requirements and community concern about RF exposure has led legislators to consider methods of advising the community about radiation levels surrounding telecommunications towers and building locations. One method of approach in Australia is to provide web-based access to paying customers. The essential elements of the software include:

Geographic location of all radiators
Antenna structures and maximum radiated power
Three-dimensional layout of all antennas and reflecting surfaces on the tower
Calculation engine for total exposure levels
Graphical representation of radiation levels

The classification of the radiating structures into aperture (including reflector antennas such as parabolic dish antennas), panel or wire type antennas is usually available from the current database in Australia. In some cases, details about the physical structure of the antennas are not available. Often the only radiation information stored by the central regulatory authority is two perpendicular planes of far field radiation pattern. From this limited information a significant problem lies in the efficient computation of the near fields.

In the case of a single wire dipole, the use of a three-point radiator representation has been shown to be effective in near field calculations (Ebersbach & Thiel, Australian Antenna Symposium 2003). This theory has now been extended to both Yagi-Uda antennas and dipole arrays with satisfactory accuracy. This approach requires knowledge of the wire structure of the antenna.

In this paper, techniques to deduce the structure of wire antennas from the far field radiation patterns, and the subsequent calculation of the near field strength are presented. A comparison with NEC based calculations verifies this approach. Similar techniques are also under development for aperture and panel antenna types. These techniques lie at the core of the calculation engine for near field exposure limits available to the public.