Abstract

A complete Method of Moment analysis of different types of wire antennas, both as transmitting antenna and Electromagnetic Interference (EMI) sensor, is the subject matter of this thesis. The antenna elements studied are simple dipole wire antenna, loaded wire antennas (e.g. inverted L, T, I and C-shaped antennas), folded dipole, loop antenna and wire antennas in the presence of other parasitic elements. For the performance evaluation of the transmitting antennas, the input impedance and radiation pattern has been evaluated. The important work performed in this thesis is the evaluation of the antenna factor of these antennas when used as EMI sensor. The antenna factor represents the ratio of the incident electric field strength at the location of the antenna (with the antenna absent) to the voltage at the output terminals of the receiving antenna, when terminated with a 50Ω load. The antenna factor is the mostly used performance descriptor of EMI sensors.

When a wire antenna is used as EMI sensor in different EMI test environment (e.g. Gigahertz Transverse Electromagnetic (GTEM) Cell, Open Area Test Site (OATS), Anechoic Chamber), the wave impedance may vary from one test site to the other. The effect of the wave impedance on the antenna factor was not considered earlier and has been attempted in this thesis.

For the accurate determination of the incident electric field on the antenna, the cross polarization reception or isolation characteristic of a sensor should be known. The effect of the cross-polarized incident electric field is more prominent for loaded sensors (e.g. inverted L, T, I and C-shaped antennas) and therefore has been studied in this thesis.

The performance of these antennas for wideband application has been studied for both in transmitting and receiving mode in terms of the phase versus frequency response of the transmitted / received signal. The Method of Moment with pulse basis function and point - matching technique has been used to evaluate the current distribution on different transmitting and receiving wire antennas. Algorithms have been developed for the determination of the various quantities involved. The numerical results have been compared with the theoretical and measured results available in the literature and / or with the simulated results using the electromagnetic simulators, whenever possible. The work has been organized in the following heads:

- **Chapter 1** *of this thesis contains a detailed survey of literature available on wire antennas and wire-like structures as transmitting antenna and receiving antenna / sensor. The gaps in the works on wire antennas / sensors reported so far are also dealt with.*
- **Chapter 2** *reviews the theory for the evaluation of the input impedance and radiation pattern of wire antennas of different lengths and radii using Method of Moment with pulse basis function and point – matching technique. The comparisons of the theoretical results are made with other results achieved using commercial electromagnetic simulation packages.*

- **Chapter 3** *describes the theory and results for the antenna factor of wire antenna of different lengths and radii, when used as EMI sensor. The result for antenna factor has been validated with the chart supplied by the manufacturer of an Anritsu Dipole.*
- **Chapter 4** *is concerned with the analysis of the wire antenna as EMI sensor when placed in different test environment with wave impedance different from that of the free space. The antenna factor has been evaluated for an Anritsu dipole when placed in a Gigahertz Transverse Electromagnetic (GTEM) Cell with wave impedance of 50Ω. The results for the computed electric field has been reported and compared with the experimental data.*
- **Chapter 5** *describes the effect of the presence of other parasitic element / antenna on a transmitting wire antenna. The input impedance and radiation pattern has been evaluated and tested against the simulated results using electromagnetic simulation packages.*
- **Chapter 6** *considers the effect of the presence of other parasitic element / elements on the antenna factor of a receiving wire antenna / sensor.*
- **Chapter 7** *contains the study of the transmitting behavior of different loaded transmitting wire antennas (e.g. inverted L, T, I and C-shaped antennas). The theoretical results for the resonant length and corresponding resonance resistance of these antennas have been reported.*
- **Chapter 8** *introduces the performance of reduced - length antennas (e.g. inverted L, T, I and C-shaped antennas) as EMI sensor. The cross-polarization characteristics of these antennas have also been studied.*
- **Chapter 9** *describes the performance of different transmitting and receiving antennas for wideband applications. The phase versus frequency characteristics of the transmitted / received signal for different loaded and unloaded transmitting / receiving antennas have been reported here.*
- **Chapter 10** *sums up the achievements in this thesis, based on the analysis and results presented.*

Keywords

Method of Moment, Pulse basis function, Point – matching, Vector potential approach, Wire antenna, Input impedance, Radiation pattern, Electromagnetic Interference (EMI), EMI sensor, Antenna factor, Gigahertz Transverse Electromagnetic (GTEM) Cell, Parasitic element, Mutual impedance, Loaded antenna, Inverted L - antenna, T – shaped antenna, I – shaped antenna, C – shaped antenna, Resonance resistance, Resonant length, Folded dipole, Square loop antenna, Cross – polarization, Complex Antenna Factor (CAF).