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Numerical and Experimental Impedance Analyses of a Dipole Antenna in the Vicinity of Deionized Water at Different Temperatures

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1-Introduction

Analysis of electromagnetic wave scattering by dielectric and magnetic bodies is faced in various systems and design processes due to its wide range of applications. In this report, a near field scattering problem is investigated with adopting a thin-wire antenna in proximity of a dielectric body with rectangular cube shape. Pure water at different temperatures is employed as the dielectric body and results of numerical analysis using mixed-domain MoM are compared with FDTD results and experimental data.

2-Numerical Analysis of the Problem

Regarding MoM, we have adopted the three-dimensional polynomial function with a combination of entire-domain and sub-domain expansions in MoM. Details can be found in [1] and [2]. FDTD method is also applied to get the numerical results to be compared with MoM results.

3-Experimental and Simulation Results

The employed model of a linear monopole antenna in the vicinity of a dielectric body over a conducting plate is shown in Figure 1. Measurement of complex permittivity of water has been carried out using HP 85070B Dielectric Probe Kit and the measured data has been used during MoM calculation. Frequency dependent FDTD analysis using the recursive convolution method and debye relation was also performed. Input impedance of the dipole antenna (monopole at the presence of conducting plate) in vicinity of the rectangular box of water at two temperatures of $18^{\circ}C$ and $50^{\circ}C$ is shown in Figures 2 and 3, respectivly. It can bee seen that at $50^{\circ}C$ case, the numerical results of MoM and FDTD method agree well and have almost equal differences with experimental data. But in the case of $18^{\circ}C$, the experimental data agrees with MoM results better than FDTD results.

4 -Conclusions

MoM and FDTD method and an experimental approach were applied to analyze the input impedance of a dipole in the vicinity of deionized water at different temperatures. It was observed that in low temperature case, when the water has higher permittivity index, numerical results of MoM have better agreement with experimental data than that of FDTD results.

References

[1]A.Saeedfar,K.Sawaya,"Accuracy Improvement in Moment Method Solutions of the Tensor-Volume Integral Equation for Three-Dimensional Dielectric Scatterers", Proceedings of the *ISAP '05*, Seoul, Korea,

[2]A.Saeedfar,K.Sawaya,"Mixed-Domain MomentMethod Solution of the Tensor-Volume Integral Equation for Three-Dimensional Dielectric Scatterers", Proceedings of the *ICEAA05*, Torino, Italy

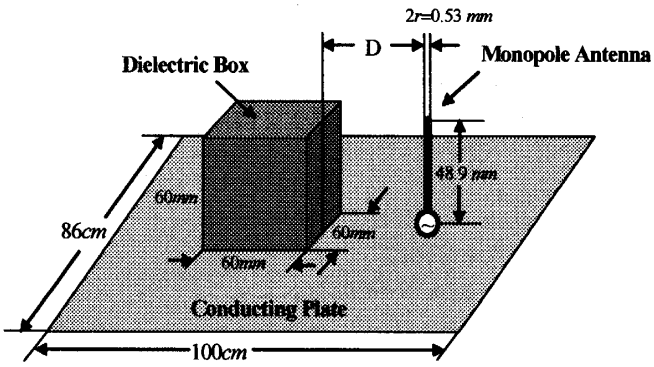

Fig.1: Analysis model

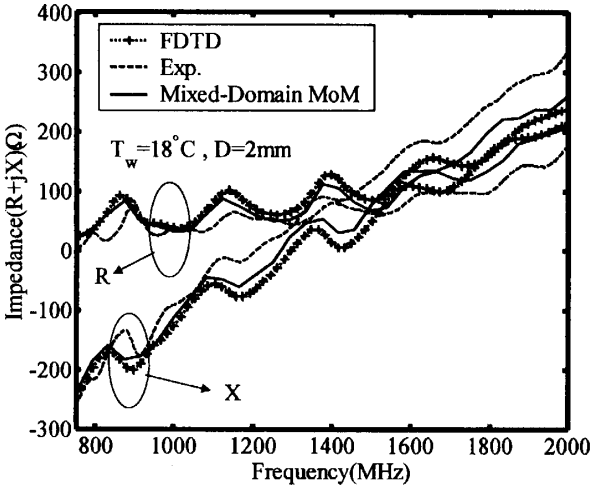

Fig.2: Input Impedance of the dipole at $18^{\circ}C$

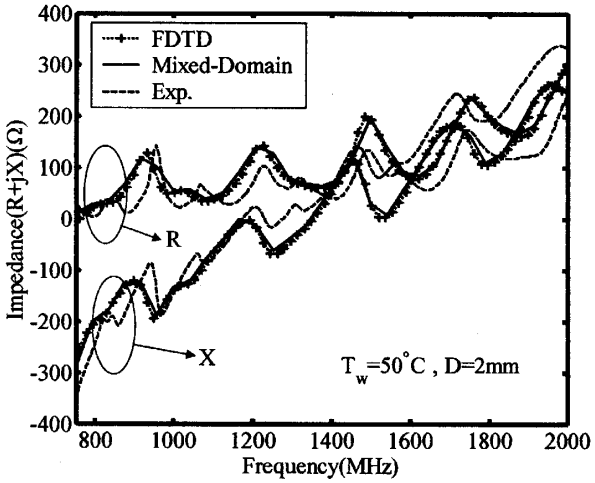

Fig.3: Input Impedance of the dipole at $50^{\circ}C$