ACCURATE AND EFFICIENT STUDY OF RF CAVITIES BY USING A CONFORMAL FDTD METHOD

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Abstract

This work introduces a conformal finite difference time domain (CFDTD) method as implemented in VORPAL to accurately and efficiently study RF cavities. For illustration, an A6 magnetron cavity has been employed and the corresponding dispersion relation has been carried out. The accuracy of the CFDTD method is measured by comparing with SUPERFISH calculations. To verify the accuracy of the CFDTD simulations, a geometric model has been constructed in VORPAL and simulated with different mesh numbers as 10,000, 40,000, 90,000, 160,000, and 250,000 for three DM_FRAC values equal to 0.75, 0.5 and 0.25, respectively. The results show an accuracy of 99.4% can be achieved by using only 10,000 meshes with Dey-Mittra algorithm. By comparison, a mesh number of 360,000 need be used to preserve an accuracy of 99% in the conventional FDTD method. One should be careful using conventional FDTD to study systems with complicated geometry as the staircased meshes fail to conform the boundary correctly. The simulation time of studying the interaction of particles with fields inside cavities can be dramatically reduced by using CFDTD particle-in-cell simulation without losing accuracy.

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