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REFMULF: 2D Full-wave FDTD Full Polarization Maxwell Code

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An important tool for the progress of reflectometry is numerical simulation, able to assess the measuring capabilities of existing systems and to predict the performance of future ones in machines such as ITER and DEMO. A novel 2D full-wave FDTD code, REFMULF, presented here is able to cope with full polarization waves, coupling the Transverse-Electric Mode (TE, X-mode) with the Transverse-Magnetic Mode (TM, O-mode) via a linear vectorial differential equation for **J** with a generic external magnetic field $\mathbf{B_0}$. This equation, coupling wave propagation, described by Maxwell curl equations to the plasma media, is solved using a modified Xu-Yuan kernel [1], [2] with extended long-run stability. The external magnetic field components of $\mathbf{B_0}$ lying on the propagation plane are responsible for linking the TE and TM modes. For a $\mathbf{B_0}$ purely perpendicular to the propagation plane the code describes simultaneously o-mode and x-mode propagation. This code enlarges the possibilities of simulation of microwave reflectometry, including depolarization processes in turbulent plasmas, offering capabilities unavailable in present day 2D reflectometry codes, closing the gap to the much sought-after computationally affordable 3D code. Being a parallel code is able to cope with real size problems. Although originally written with reflectometry in mind the code can is useful to simulate other diagnostics such as Collective Thomson Scattering, or Electron Cyclotron Resonant Heating.

[1] Lijun Xu, Naichang Yuan, IEEE Antennas And Wireless Propagation Letters 5, 335-338 (2006).

[2] F. da Silva, M. Campos Pinto, Bruno Després and Stéphane Heuraux, Journal of Computational Physics 295, 24-45 (2015).

Eligible for student paper award?

No

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