Benchmarking 2D against 3D FDTD codes for the assessment of the measurement performance of a low field side plasma position reflectometer applicable to IDTT

F. da Silva [1], E. Ricardo [1], J. Ferreira [1], J. Santos [1], S. Heuraux [2], T Ribeiro [3], A. Silva [1], G. De Masi [4], O. Tudisco [5], R. Cavazzana [4], O. D'Arcangelo [5]

1) Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Lisbon, Portugal
E-mail : tanatos@ipfn.tecnico.ulisboa.pt
2) Institut Jean Lamour, Université de Lorraine, CNRS, F-54000 Nancy, France
3) Max-Planck-Institut für Plasmaphysik, Garching D-85748, Germany
4) Consorzio RFX C.so. Stati Uniti,4, 35127 Padova, Italy
5) Associazione EURATOM-ENEA-CR Frascati, 00044 Frascati, Italy

O-mode reflectometry, a technique to diagnose fusion plasmas, is foreseen as a source of real-time (RT) plasma position and shape measurements for control purposes in the coming generation of machines such as DEMO. It is, thus, of paramount importance to predict the behavior and capabilities of these new reflectometry systems using synthetic diagnostics. The use of finite-difference time-domain (FDTD) time-dependent codes permits a comprehensive description of reflectometry, including aspects such as propagation in the plasma, the system location within the vacuum vessel, its access to the plasma or the signal processing techniques. FDTD is a computationally demanding technique, especially when it comes to three-dimensional (3D) simulations, which requires access to HPC facilities. This fact makes the use of two-dimensional (2D) codes much more common. It is important to have a good evaluation of the compromises made when using a 2D model in order to decide whether it is applicable to the problem under study, or if the problem rather requires a 3D approach.
This work attempts to answer this question by comparing simulations of a potential plasma position reflectometer (PPR) at the Lower Field-Side (LFS) on IDTT carried out using two full-wave FDTD codes, REFMULF (2D) and REFMUL3 (3D). In particular, the simulations consider one of IDTT's foreseen plasma scenarios, namely, a Single Null (SN) configuration, at the Start Of Flat (SOF), the start of the flat top of the plasma current.