Joint DESY and University of Hamburg Accelerator Physics Seminar

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ZOOM video seminar (needs version 5.0+)

Contemporary Challenges in Computational Accelerator Physics

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Abstract

The talk addresses several large-scale electromagnetic field solvers and particle trackers dedicated to accelerator physics, as they are developed and used at the Institute for Accelerator Science and Electromagnetic Fields (TEMF). Highly accurate solutions for the eigenmodes of superconducting cavities are obtained with a parallelized nonlinear eigenvalue finite-element solver, capable of tackling small but relevant geometric details in e.g. the higher-order mode couplers and utilizing perfectly electric, perfectly magnetic, impedance and port boundary conditions. Beam-induced wakefields and the corresponding impedances in long, possibly corrugated and tapered structures are assessed with a moving-window dispersion-free and highly parallelized Finite-Integration-Technique (FIT) solver in time domain or, recently, with a high-order frequency-domain finite-element (FE) solver. Impedances of arbitrarily long accelerator structures can be computed by a generalized S-parameter concatenation technique. Large-scale time domain simulations using high-order Discontinuous Galerkin (DG) techniques have been applied for the estimation of coherent-synchrotron-radiation wakefields in the XFEL bunch compressors as well as in beam dynamics studies for the plasma-wakefield-acceleration experiments at PITZ. Using specialized particle tracking codes based on the fast multipole method and a Liénard-Wiechert space-charge interaction model, accurate beam dynamics simulations can be performed from the cathode up to the undulator. The increasing challenges on performance, reliability and efficiency of accelerator components impel further improvements to these tools, which will be sketched and motivated. A few selected examples will illustrate the features of the tools and the skills of the accelerator physicists behind them.

W.Hillert, (Univ. HH), I.Agapov (MPY) and M.Vogt (MFL).