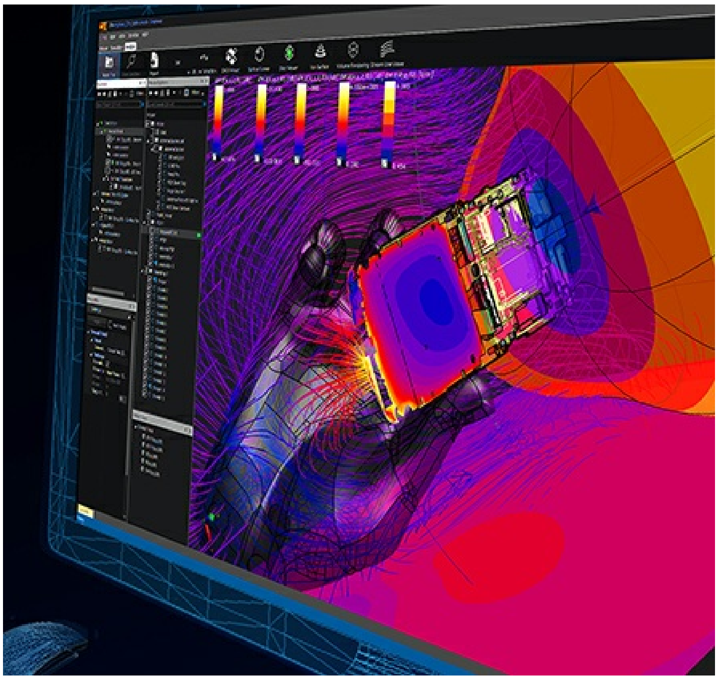
Physics Models: P-EM-FDTD

Electromagnetics Full Wave Solvers

The Electromagnetics Full Wave Solvers (P-EM-FDTD) enable accelerated full-wave, large-scale EM modeling (> billion voxels) with Yee discretization on geometrically adaptive, inhomogeneous, rectilinear meshes with conformal sub-cell correction and thin layer models, with support for dispersive materials. The solver includes a unique adaptive subgridding algorithm (from Acceleware) that facilitates the highest possible effectiveness in local mesh refinement.



Near-field and over-the-air (OTA) optimization of complex transmitters for handheld or body-mounted devices.

Optimal simulation speed is achieved with native Graphics Processing Unit (GPU) and MPI accelerations, which were developed by our team who first introduced EM accelerated solvers together with Acceleware in 2006.

The unique bidirectional Huygens box approach overcomes the difficulties associated with models that extend across multiple scales and require widely varying resolutions.

These solvers, the most frequently applied of their kind in near-field dosimetry, have been have been extensively validated and documented according to the IEEE/IEC 62704-1 standard as well as by comparisons with measured data (> 200 publications). Comprehensive documentation is available for [Sim4Life](https://zmt.swiss/sim4life).

Application Areas

- MRI pTx RF Coil Design
- MRI Rx RF Coil Design
- MRI RF Coil Design with Gradient Interaction
- MRI Tx RF Coil Design w/ Gradient Interaction & Safety
- MRI Gradient Coil Design
- Active and Passive Implants MRI Safety
- RF Hyperthermia
- RF Tumor Ablation
- Biomedical Devices
- SAR Assessment

Key Features

- Transient, Broadband, and Harmonic simulations (Time-Domain Solver)
- Results from time and frequency domains
- Automatic simulation termination
- ARMA engine for early time convergence detection
- Non-homogeneous intelligent gridder engine (geometry detection)
- Unique adaptive subgridding algorithm (from Acceleware)
- Run-time monitoring
- Non-linear materials (Kerr-Effect, Raman-Scattering)
- Lossy real metals, thin metal sheets and coatings
- Temperature relevant parameters for T and EM-T solver
- Predefined materials database (metals, dielectrics, anatomical)
- User-defined signal source (pulse, step, saw, arbitrary, etc.)
- Discrete sources (1-D, single edge)
- Plane-wave and Huygens
- Lumped elements (R, L, C, predefined serial/parallel)
- Parametric sources, lumped elements, sensors
- ABC, PEC, PMC, periodic boundaries
- Analytic boundaries (Mur, Higdon)
- UPML and CPML boundaries with adjustable absorption
- Execution through Command Line or GUI
- SIBC accelerated for Broadband and Harmonic simulations
- Fully automated multi-port

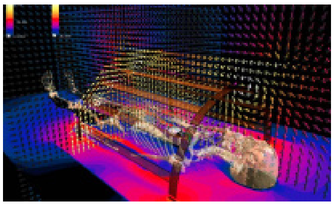
- Lossy dielectric and magnetic materials
- Frequency-dependent dielectric and magnetic materials (Debye, Lorentz, Drude, Drude-Lorentz)
- Metamaterials (double negative)

box sources (total-field /scattered-field)

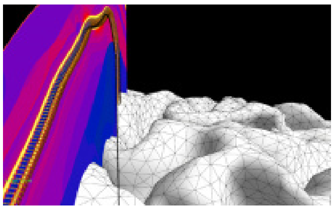
- Remote and Iterative Huygens engines (incl. backscattering)
- Anisotropic materials support for EM FDTD CUDA accelerated solvers

SParameter extraction

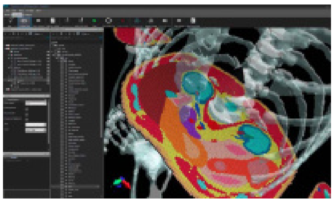
- Results of S-Parameters extracted vs. frequency or in steady state



MRI birdcage design: Analysis of load dependence.



Evaluation of an MR-safe deep brain stimulator implant.



Fast and accurate rectilinear discretization of an anatomical human model.

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