# XFdtd® Release 7

for the Biomedical and MR Community

Ensuring that all new devices meet regulatory and certification requirements is a necessity. Remcom's tools can greatly speed the design and certification process by allowing realistic simulations of the device performance before the costly prototyping stage. Analysis options are both device-oriented, such as tuning, and bio-interaction related, including SAR. Realistic human body models are available in addition to CAD-based phantom models. Here are some Bio/EM analysis areas Remcom specializes in:

- Imaging Devices including MRI coil design and tuning, SAR and field analysis
- Implantable Devices (pacemakers, diagnostic equipment)
- Field Exposure from radiating sources (cell phones and other antennas)
- Human Models and Phantoms
- Regulation/Certification
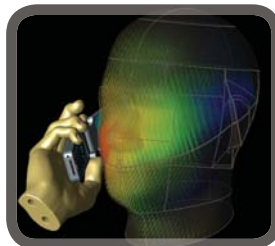
## XFdtd Bio-Pro for Calculation of Biological Effects of Electromagnetic Fields

Bio-Pro is a specialty version of XF that provides accurate prediction of the interaction of electromagnetic fields with biological tissues. It includes important bio-EM calculation capabilities such as saving of all steady state conduction currents, electric fields, and magnetic fields. Other key features include:

- Calculation of Specific Absorption Rate (SAR) including whole body, 1 gram, and 10 gram averages
- Biological Thermal Sensor
- VariPose® Mesh Repositioning

- MATLAB® Export Functionality
- Hearing Aid Compatibility (HAC)
- MR-related Output Types
- Birdcage Tool

XFdtd

Visit **www.remcom.com/xf7** for a detailed feature list, system requirements and licensing information.

REMCOM®
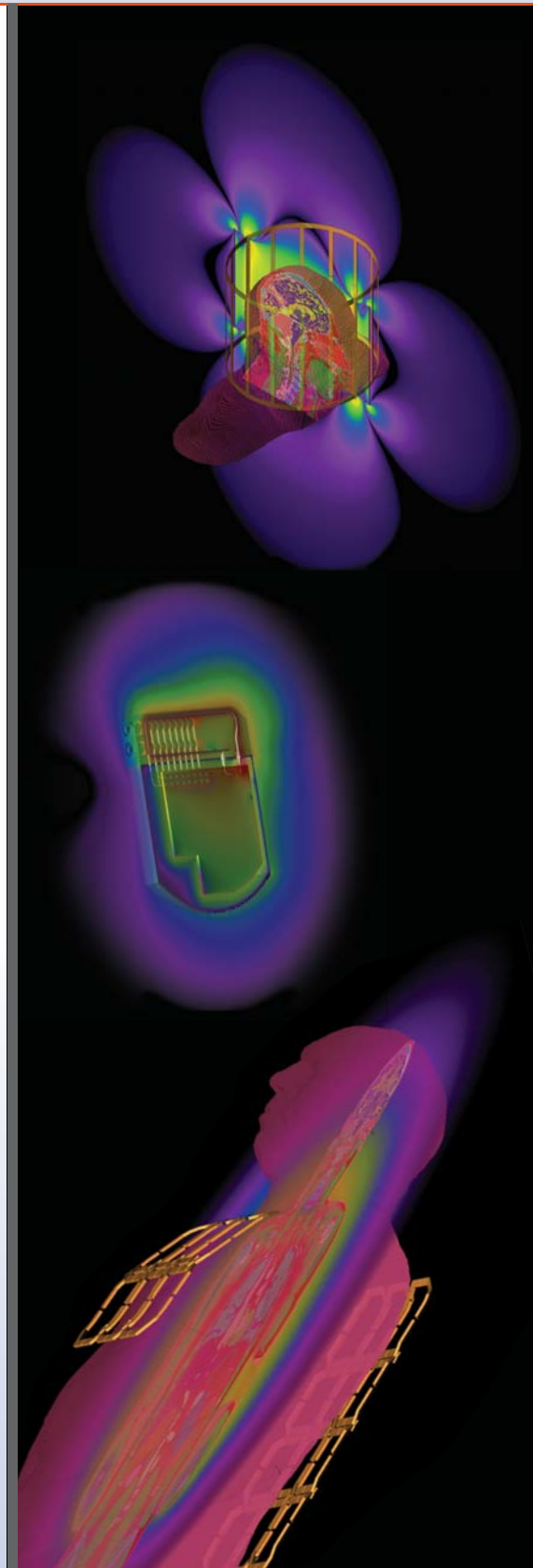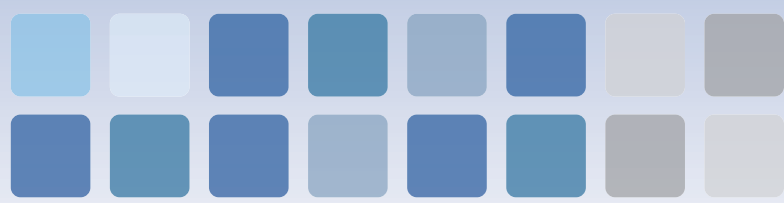
Biological Thermal Sensor

XFdtd's enhanced Thermal Sensor allows metals and other non-biological objects to be included in the temperature rise computation. The calculations are based on Penne's Bio-Heat equation and consider the effects of conductive heat transfer between thermally connected materials, blood perfusion, metabolic processes, and general RF heating. The sensor is well suited for analysis related to:

- Therapeutic heating devices
- MRI heating in patients, including effects of implants, probes, and electrodes

- Microwave thermal ablation
- Implantable devices

Output from the sensor includes the initial temperature, temperature rise, and final temperature distributions. This data can be visualized in the user interface or exported for custom post processing.
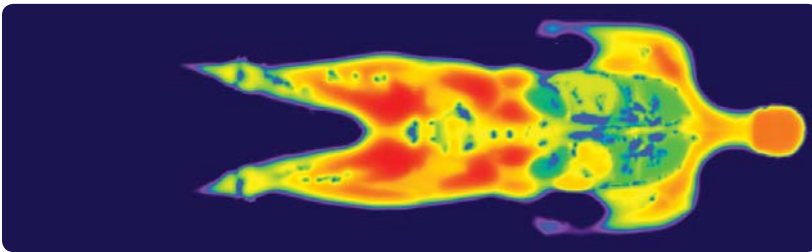
*Computed initial temperature distribution for a human showing the effects of metabolic processes.*
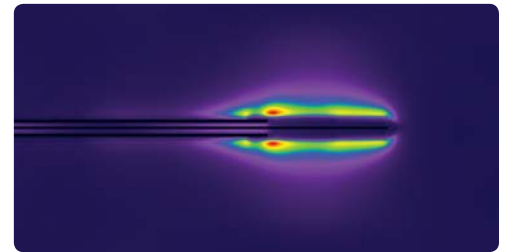
*Temperature increase around a probe that has been inserted in liver tissue.*

MATLAB Export Functionality

All data available through XF's Result Browser can be exported to MATLAB and CSV formats. This enables full post-processing of data with MATLAB's extensive mathematical and visualization capabilities. The following list highlights what is included in the export, but is not exhaustive:

- E, H, B, and J fields for point, planar, and volumetric sensors
- Rotating B+/- and SAR results
- Grid vertex locations and Mesh material properties needed for custom SAR post-processing
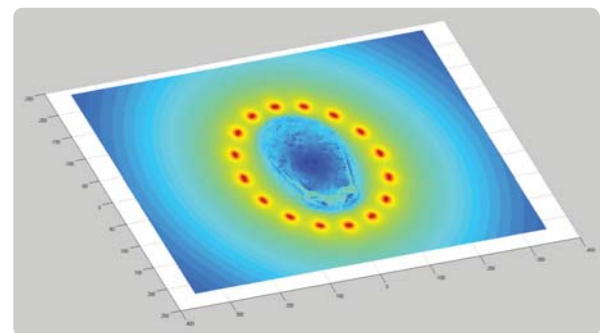
Electric fields on horizontal plane passing through an MRI birdcage coil and human brain in MATLAB.
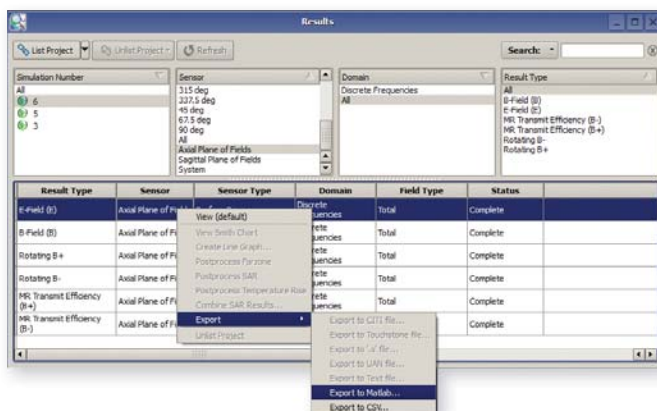
*Export to MATLAB or CSV option in Results Browser.*

Birdcage Tool

The Birdcage Tool provides the ability to quickly build an MR birdcage coil and prepare it for simulation. A series of tabs guides users through the process of creating a birdcage:

- Specify geometric details
- Set the resonant frequency
- Create and/or assign a waveform

- Create and/or assign capacitors
- Choose the number of sources to excite the structure

Birdcage designs included are High Pass, Band Pass, Low Pass, and Source-Driven Homogeneous, all with numerous variable dimensions. Upon completion, the birdcage tool will create the specified geometry and also create and attach all necessary circuit components, create and/or assign the waveform and set source phases and time delays.
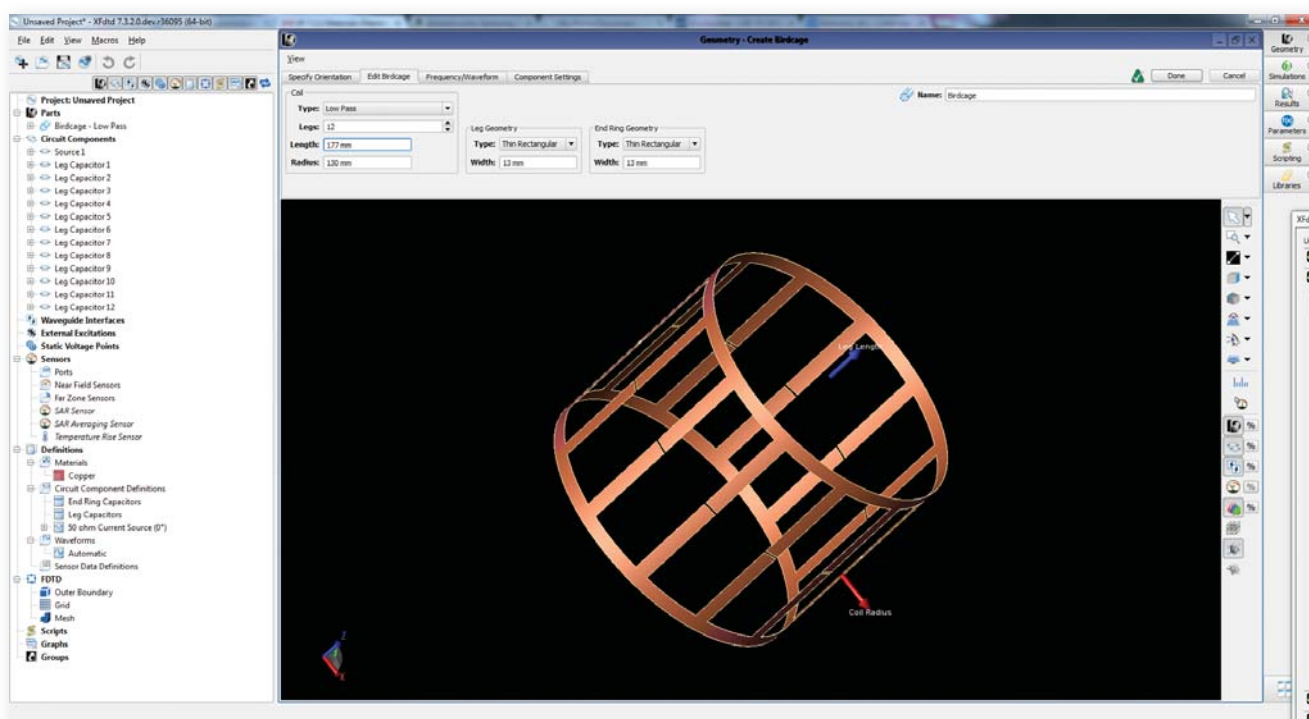
MR-Related Output Types: MR Transmit Efficiency and Approximate MR Image

XF includes output types for medical imaging simulations. MR Transmit Efficiency is proportional to the signal-to-noise ratio (SNR) for an MR birdcage, a single loop, or a specific set of amplitudes and phases for an MR phased array. The Approximate MR Image is a representation of the actual image generated by the coil, based on the rotating B-field output (B_1+) and the water ratio data of the biological tissues in the simulation.
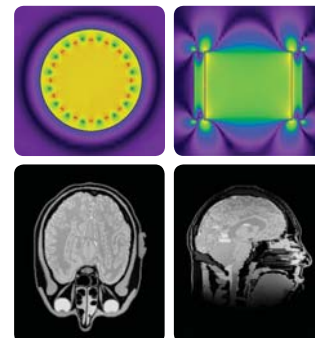
■ Bio/EM Results & Features:

- Specific Absorption Rate (SAR)
- Biological Thermal Sensor calculates temperature rise
- Biological Tissue Parameters: water ratio, heat capacity, thermal conductivity, perfusion by blood, metabolic heat
- Birdcage Designer
- MATLAB Export Functionality
- MR Transmit Efficiency (proportional to signal-to-noise ratio)
- Approximate MR Image
- B_1^+/B_1^- Fields
- Combined SAR results from multiple simulations
- Calculate 1- and 10-gram SAR averages
- Whole body SAR average
- Location of peak SAR
- Adjust SAR levels for specified input power or current
- Planes of SAR for color display
- SAM head CAD file
- Hearing aid compatibility (HAC)
- Head and body meshes at various resolutions
- VariPose® to reposition body meshes
- ICRP, NICT and Virtual Population voxel models supported
- Automatic assignment of correct biological materials to all imported voxel types
- SAR statistics reporting (mass, dissipated power, mean SAR over regions)

■ Other Key Features:

- 64-bit version
- Multi-platform GUI and solver – Windows, Linux
- XACT Accurate Cell Technology® – Advanced sub-cellular conformal method for resolving complex curved surfaces and small gaps
- XTend Script Library automates modeling with pre-loaded, customizable scripts for creating custom features
- External Queue Integration (EQI)
- CAD Merge for integrating new versions of CAD and PCB designs into existing projects
- Extensive materials library
- Full parameterization
- Macros
- Custom project templates
- Persistent results
- Simulation queue
- Interactive graph manipulation
- Real-time error checking with feedback
- Automatic mesh fixed-point detection
- Dissipated power maps

■ High Performance Computing & Acceleration:

- Market leader for electromagnetic simulation acceleration
- XStream® GPU Acceleration using NVIDIA's CUDA architecture
- Message Passing Interface (MPI) for CPU and GPU clusters
- Unlimited Memory Support
- Complete parallelization including GPU, multi-processor, MPI

XFdtd® Simulation Throughput vs. Number and Type of Processor
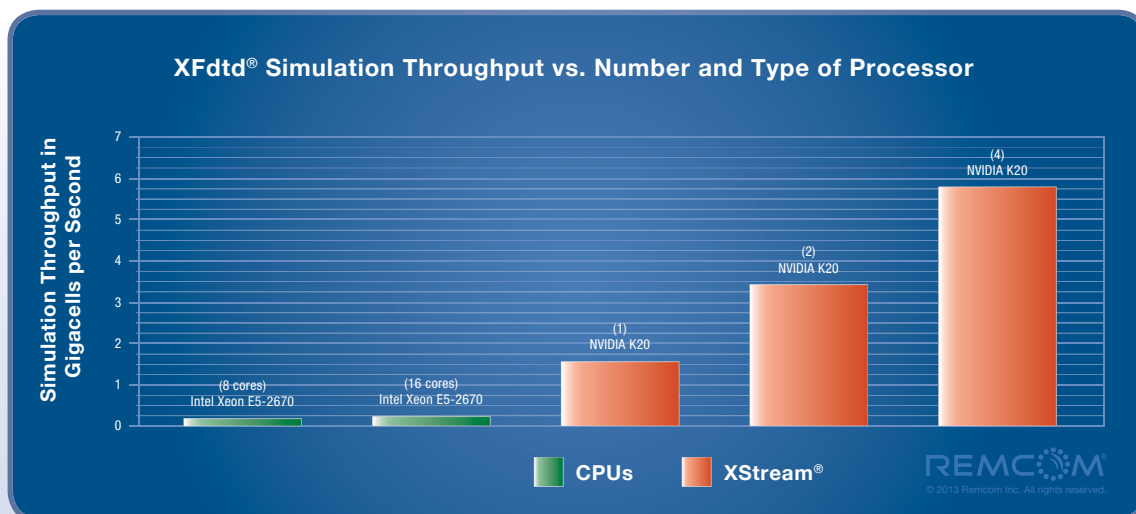
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