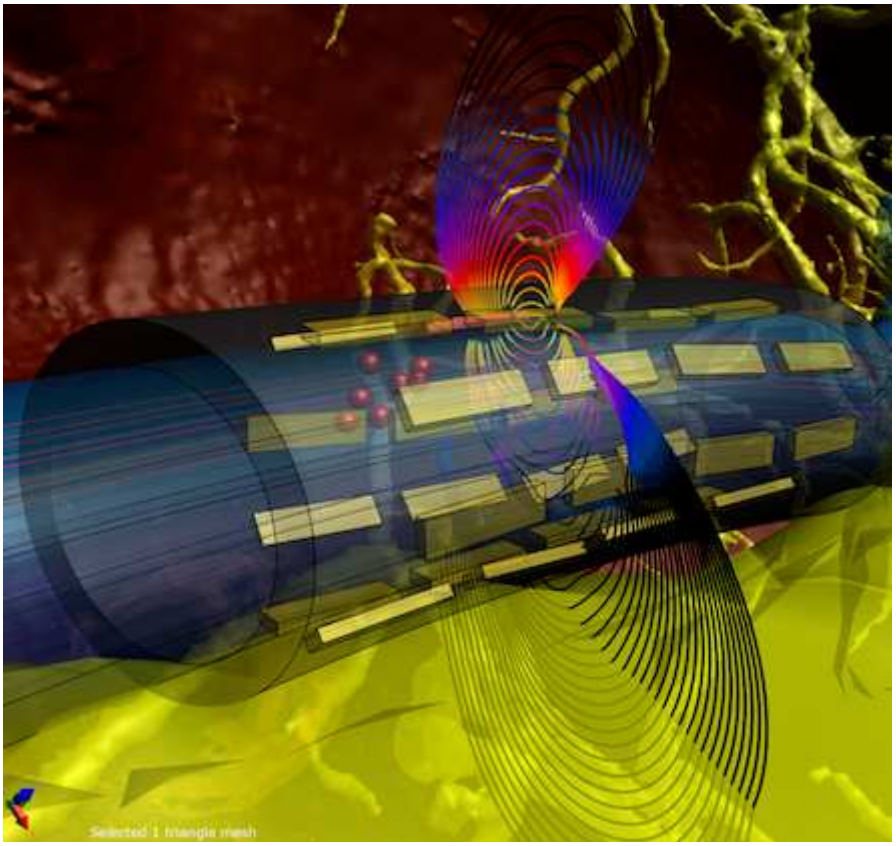
Tissue Models: T-NEURO

Neuronal Tissue Models

The Neuronal Tissue Models (T-NEURO) enable the dynamic modeling of EM-induced neuronal activation, inhibition, and synchronization using either complex, multi-compartmental representations of axons, neurons, and neuronal networks with varying channel dynamics, or generic models. Sim4Life uses the NEURON solver developed at the Yale University which is ideal for studying interaction mechanisms, evaluating and optimizing neurostimulating devices, and assessing safety issues.



Stimulation of the vagus nerve with a multi-element cuff electrode array.

Embedded geometrical and dynamical representation of neurons (soma, axon, and dendritic tree) generate physiologically functionalized anatomical models. (coming soon)

The SENN model (safety standards) and more complex models can be applied inside whole-body models. The graphics user interface (GUI) facilitates the integration of other neuronal models from commonly used databases or independently derived models.

T-NEURO has been validated against published data and *ex vivo* and *in vivo* measurements, and is continually advanced and validated.

Application Areas

- MRgFUS Neurosurgery Applications: Tumor Ablation, Neuropathic Pain Treatment, Movement Disorders
- FUS-Based Neural Stimulation
- Neuro-Prosthetics (retina, cochlea, vestibular, motor)
- EM Neuro-Stimulation
- Neuro-Motoric Incapacitation
- High LF-EM Field Safety Assessment (e.g., MR Gradient Coils)
- Pacemaker
- Temperature Impact on Neuronal Dynamics

Key Features

Dynamic modeling of EM-induced neuronal activation inhibition & synchronization

Unidirectional coupling with the EM-QS and Thermal solver

SENN model can be applied inside whole body models

Interface allows integration of other neuronal models from commonly used databases

User-friendly import & visualization of nerve geometries from commonly used databases

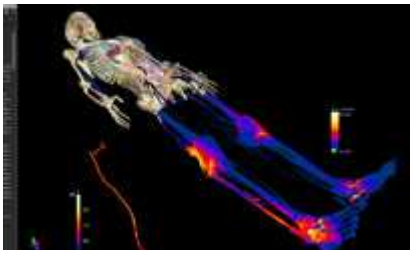
Determining thresholds through titration procedure

Detection of neuronal spikes and their occurence times

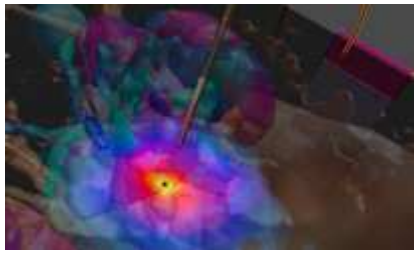
Novel spatially varying temperature dependence impact on the neuronal dynamics

Capturing & plotting membrane dynamics over time

Easily define pulse sources that correspond to gradient switching fields



Neuronal response modeling in MRI gradient switching fields with RF induced local temperature increases considered.



Improved DBS treatment analysis facilitated by the head model with incorporation of the Morel stereotactic atlas of the thalamus.

Propagation of the transmembrane voltage in a rat hippocampus neuron with a detailed dendritic tree.