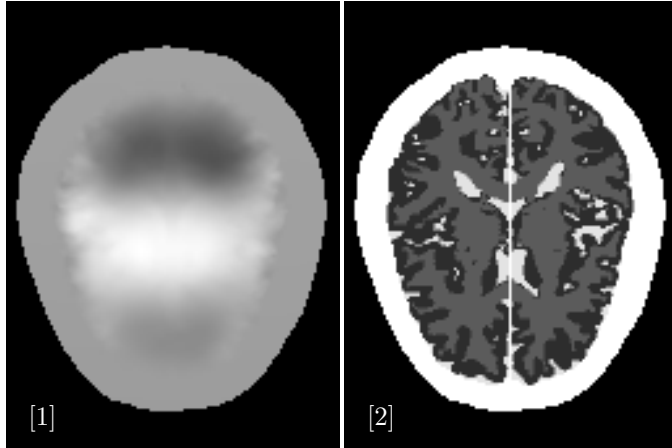# Description for the FEM simulation of a human brain

This is an FEM simulation of a human brain. This simulation was generated by, and provided to Charité-BIOQIC by, **Cemre Ariyurek**, National Magnetic Resonance Research Center (UM-RAM), Bilkent University, Ankara, Turkey.

centerslice of the displacements[1] / prescribed stiffnesses[2] of the FEM simulation of a human brain

Technical Description

A technical description from Barnhill et al (in review) is as follows:

A 3D model of human brain was developed from segmented images of a healthy human, consisting of scalp, skull, cere- brospinal fluid, gray matter and white matter [1]. Furthermore, since falx cerebri affects wave displacement fields severely, segmentation of falx cerebri was added manually. The model was imported to COMSOL Multiphysics (COMSOL, Stock- holm, Sweden) finite element method (FEM) software and Young's modulus, Poisson's ratio and density parameters were assigned to the segmented parts, reported in previous studies. Damping parameters were assigned to gray matter and white matter, using stiffness damping of Rayleigh damping, similar to a previous study. Stiffness damping was computed using $\beta = (G''/G')/\omega$, where G ' is the storage modulus, G " is the loss modulus and ω is the excitation frequency. Frequency domain analysis was performed by rota- tionally vibrating the head around y-axis (anterior-posterior), similar to head bobble motion or the excitation of a bite actuator. The excitation frequency was swept from 24 to 60Hz with 4Hz increments. Applied peak input displacement was 10μm. Mesh sizes were chosen to satisfy having at least 10 mesh elements per wavelength. Complex displacement field data were exported with 1.5mm isotropic voxels.

The data is in 5D complex MATLAB format (3D space, 1D directions, 1D frequencies). Brain-SimDisplacement.mat contains the displacements and BrainSimG.mat contains the prescribed stiffnesses.

Summary

Index description:

Index	Physical Meaning	Dimension length	Sorting
1	y-coordinate (row index)	128	ascending
2	x-coordinate (column index)	171	ascending
3	z-coordinate (slice index)	33	ascending
4	motion encoding direction index (y,x,z)	3	1: along y-axis 2: along x-axis 3: along z-axis
5	frequency index	10	[24 28 32 36 40 44 48 52 56 60] Hz (ascending)

Image information:

voxel size	[1.5 1.5 1.5] mm
orientation	feet to head