

## # Custom Head Volume Conduction Model Documentation (makeheadmodel.m)

This documentation provides instructions on how to create a custom head volume conduction model in MATLAB using subject-specific magnetic resonance imaging (MRI) data. The code provided below assumes a specific folder hierarchy for the MRI data and requires several input parameters.

### ## Prerequisites

Before using the code, ensure you have the following prerequisites:

1. MATLAB installed on your computer.
2. FieldTrip toolbox for MATLAB, which can be downloaded from [FieldTrip website](<http://www.fieldtriptoolbox.org/download>).
3. EEG electrode locations in the "SXX\_chanlocs.txt" format.
4. Subject-specific MRI data in the expected folder hierarchy: `...\Data\SXX\MRI`.

### ## Input Parameters

The code requires several input parameters to create the custom head volume conduction model:

- ``savePath``: The output folder where the new EEG dataset will be saved after dipole fitting.
- ``eeglab_path``: The path to the EEGLAB toolbox.
- ``electrodelocs_path``: The input path to the EEG electrode locations in the "SXX\_chanlocs.txt" format.
- ``subjectList``: An array of subject numbers to process.
- ``EEGchanfile``: The name of the channel location .txt file, usually generated from ``getchanlocs()``. It should contain fiducial locations if you want to coregister the head model/MRI and electrode locations.
- ``MRIfolder``: The input folder with MRI files.
- ``MRIfilename``: The name of the MRI file (raw or normalized).
- ``inputMRItypes``: Options: 'raw' or 'norm', indicating whether the MRI file is raw or normalized.
- ``outputCoordSys``: Options: 'MNI' or 'CTF' (recommended). The output coordinate system of the head model. 'MNI' is spatially normalized to the MNI coordinate system, while 'CTF' is in subject coordinate space.

### ## Outputs

The code generates several outputs:

- ``mri_segmented``: The segmented MRI data.
- ``mri_seg_i``: The segmented MRI in indexed format.
- ``fidLocsMRI``: Locations of fiducials (nas, lhj, rhj) marked on the MRI.

- `'headmodel_fem'`: The head model created using finite element analysis (FEM).
- `'mesh_fem'`: The mesh data.
- Optionally, you can visualize intermediate steps by setting `'plotStuff'` to 'on'.

## ## Usage Instructions

1. Place your subject-specific MRI data in the `'...\Data\SXX\MRI'` folder hierarchy.
2. Modify the input parameters at the beginning of the code according to your specific dataset and preferences.
3. Ensure that the FieldTrip toolbox is correctly installed and the paths are set.
4. Run the code in MATLAB.

## ## Detailed Workflow

Here's a breakdown of the steps performed by the code:

1. Load the directory contents and iterate through the subject list.
2. Load the MRI data and realign it to the ACPC coordinate system.
3. Reslice the MRI data to make it isotropic.
4. Mark fiducials (nas, lhj, rhj) on the MRI using interactive mode.
5. Segment the MRI into scalp, skull, CSF, gray matter, and white matter compartments using FEM.
6. Create a mesh from the segmented MRI data.
7. Align the EEG electrode locations with fiducials on the MRI.
8. Create the head model using the SimBio method, specifying tissue conductivities.
9. Save the outputs, including the segmented MRI, mesh, and head model.

The code also includes visualization steps for intermediate results, which can be enabled by setting `'plotStuff'` to 'on'.

**\*\*Note\*\***: This code assumes a specific folder structure for MRI and may require adjustments if your data is organized differently.

Please ensure that you have all the required dependencies and follow the steps and parameters correctly to create your custom head volume conduction model using subject-specific MRI data.