**PROTOCOL: run FSL’s Topup and Eddy for EPI Distortion, Eddy Current, and Motion Correction**

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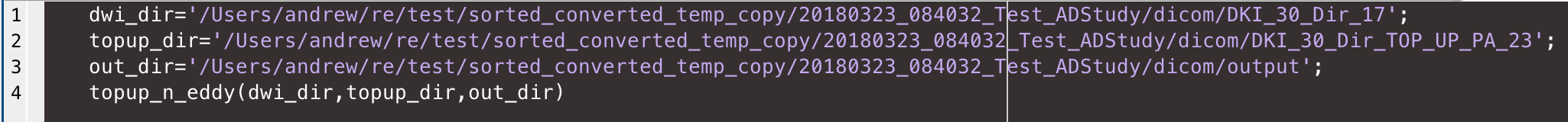
Required Software:

* FSL version 5.0 or later
* dcm2niix – packaged with MRIcroGL
  + Any version works, but dcm2niix is being updated all the time to convert a wider range of problematic images, so try the latest version if your images don’t convert correctly
* SPM12
* Required folder in Matlab path: /vdrive/helpern\_share/Protocols/BatchScript\_Templates/d2n2s
  + This can also be downloaded from the Terminal using “git clone https://git.musc.edu/jat219/d2n2s.git”

**I: Before running**

* topup\_n\_eddy.m takes in two input directories and one output. It looks through the input directories for .bval, .bvec, .nii, and .json files (one of each type), assuming that all the data in these files are from one sequence – **one folder for the DWIs, one folder for reverse phase encoding b0s**. This is exactly how things are formatted if you run dicom\_sort on your Dicoms and then dcm2niix on each relevant folder (separately). While you could use other tools to organize and convert, you would have to do a lot more finagling, and I don’t recommend that. **Note** that if you want to denoise, unring, or do any other preprocessing first, you should move the old .niis to a separate folder, then use this function on the folder with the preprocessed .nii (only) and the original .bvec, .bval, and .json files. In the future, an example script with this sort of file structure will be placed in “/d2n2s/examples/”.
* As stated above: if you want to use denoising, unringing, or Rician correction, use them before this function. Do any coregistration after this function.
* This function has only been tested on Siemens data. However, it should work on sequences from other scanners as long as dcm2niix outputs a .json file with entries for TotalReadoutTime and PhaseEncodingDirection.

**II: Run Function**

* Open Matlab and run “topup\_n\_eddy(dwi\_dir,topup\_dir,output\_dir)”. This script requires SPM12 and requires you to be able to call FSL commands from the terminal.
  + Certain earlier FSL versions do not use “eddy” on the command line, but rather “eddy\_openmp”. There are two ways to get around this:
    - 1. Change the line in “topup\_n\_eddy.m” “command=[‘eddy …” to “command=[‘eddy\_openmp …”.
    - 2. Create a symbolic link in “$FSLDIR/bin/” named “eddy” that points to “eddy\_openmp” (in the same directory).
* The command will look something like this:
* This function took 20-30 minutes to run on my iMac Pro using a dataset with 71 images – 11 of them b0s.
* Outputs of eddy will be in the folder “eddy” within the selected output folder. The corrected images are named “eddyd.nii.gz”.
* It’s important to use the “eddy\_rotated\_bvecs” instead of the original bvecs from this point forward.

**III: Quality Control**

* In your selected output folder, open “/top/my\_unwarped\_images.nii.gz”. These are the corrected b0s from Topup. You can QC these against the uncorrected b0s, “all\_b0s.nii” in the same folder. If corrections went well, this image will appear more physically plausible. (The easiest way to tell if a heavy distortion has been corrected is that the output b0s will now look much less jagged in the front and back of the skull just above the eyes.)

A picture containing indoor, sitting

Description generated with high confidence