# Motion Artefact Correction in fMRI

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***Abstract*—We began with a goal of performing motion artefact correction on the four dimensional signal generation by an fMRI. We were particularly interested in a current leading algorithm for this purpose, ICA-AROMA. We have been studying this algorithm and working on using it to implement our own motion correction pipeline. In order to focus purely on the problem of motion artefact correction, we have the leveraged some existing open source libraries to bring in some standard neuroimaging functionality like brain templating and file formats. Currently we have acquired fMRI data, created ingestion and display functionality, and are working on implementing the ICA-AROMA algorithm.**

***Index Terms*—neuroimaging, fmri, motion artefact, image processing, denoising**

## I. ICA-AROMA

We have been studying the algorithm described in [1] that is used to correct patient motion in fMRI signal. This algorithm is significant in contemporary neuroimaging studies, showing improved detection of stroke risk [2]. Our plan remains largely intact and is proceeding smoothly.

A minor change that has occurred is that the fmriprep ecosystem that we were planning to use proved needlessly complex [3]. We discovered that the overall pipeline infrastructure for working with neuroimaging signal data in Python is actually based around nipype [4]. Going to a lower level has allowed us to ignore more of the neuroimaging domain material and work directly with algorithms.

## II. Implementation

We are presently working primarily in Python for our work, since infrastructure for tricky tasks outside the scope of the project exists in well documented formats in that language. An example of such is the ability to overlay the image on a template of the brain and read in the complex file format involved.

Medical imaging file formats are entire field unto themselves [5]. In our case, we consume data in the Nifti-1 format. fMRI machines output a format called DICOM which is, apparently, less friendly to work with. We have not done much research into DICOM, and don't plan to explore it extensively. Nifti-1 will be more extensively described, as a means of more deeply exploring topics in multimedia communications. Nifti-1 has the interesting property that it was created with ease of analysis in mind. This is an interesting extension of the idea of communication, where the end user is not (solely) looking at the file and is instead doing something else with it. It makes use of compression as well to ease transfer over the Internet.

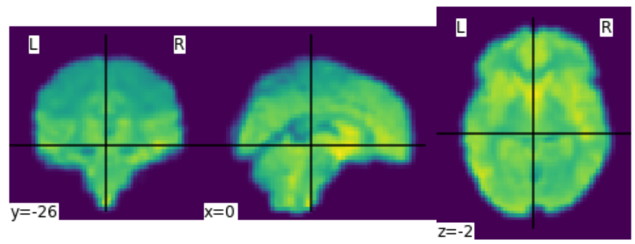


Fig. 1. Smoothing at 5mm, a choice often used in the literature

We began with the simpler task of using a Gaussian filter to smooth the images. Fig. 1 for an example of smoothing over 5mm area, Fig. 2 for an overly smoothed image (10mm), and Fig. 3 for what we view as an excellent end product that we hope our implementation will produce. We are using data released as part of the ADHD-200 contest [6], though this is subject to change. We have gathered considerable sources of fMRI data, and due to nipype and Nifti-1 most publically available fMRI data can be used more or less interchangably. The standard we will use for selection is the most impressive demo. This exact example was created using an open source implementation of the CanICA algorithm from nipype [7].

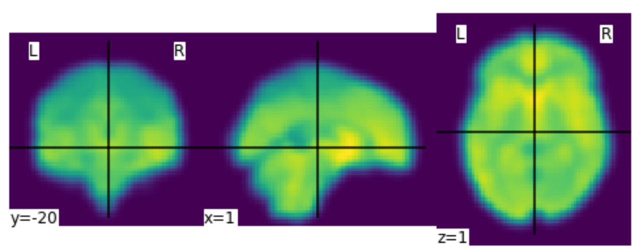


Fig. 2. Smoothing at 10mm, a somewhat ridiculous choice

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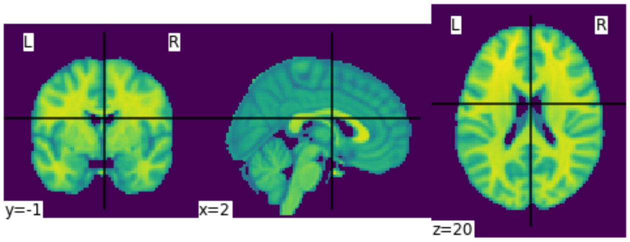


Fig. 3. A de-noised, motion-corrected, example of a successful process

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