Tutorial: Medical Image Analysis in *R*

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Abstract

Quantitative medical image analysis requires a combination of mathematical and statistical methodology to be applied to industry-defined data formats. Whether we are talking about structural assessment of tissue using computed tomography (CT), metabolic activity as measured using 18F-FDG in positron emission tomography (PET) or structural and functional measures of the brain in magnetic resonance imaging (MRI). To meet this need there is a growing collection of open-source software solutions for all aspects of data management, image processing, analysis and visualization. This tutorial will introduce packages from the CRAN Medical Imaging task view [4, 5] and apply them to structural and functional MRI data. Each section will provide a step-by-step introduction using imaging data that are available from the public domain.

By the end of the tutorial attendees will be able to:

- Read and write medical imaging data in standard formats.
- Manipulate and visualize medical imaging data.
- Apply summary statistics and statistical models to medical imaging data.
- Know where to find resources for the analysis of medical imagign data in the *R* community.

Outline

- Data import/export using **oro.dicom** and **oro.nifti** [7].
- Analysis of functional MRI using **fmri** [3].
- Analysis of diffusion-weighted MRI using **dti** [1].
- Analysis of dynamic contrast-enhanced MRI using **dcemriS4** [6].

Justification

Opportunities for statistics exist in medical image analysis, specifically MRI, because statisticians have played a limited role to date and there is a distinct lack of public-domain software in the field of medical image analysis. A notable exception is in the field of functional MRI, where brain activity is inferred from changes in the magnetic properties of cerebral blood flow. In order to take full advantage of these opportunities and expand the development of statistical methodology in medical imaging analysis we believe that a two-pronged approach is needed.

1. Introduce the field of medical imaging to statistical practitioners.
2. Educate researchers, who are interested or currently involved in medical imaging, in basic and advanced statistical techniques and make these techniques available through open-source software packages in *R*.

Potential Attendees

R users (clinicians, statisticians, medical physicists or researchers) with an interest in the quantitative analysis of neuroscience and/or oncology MRI data.

Background Knowledge

Attendees will require a basic understanding of an interpreted programming language; such as *R* (preferred) or Matlab. Attendees will also require basic understanding of statistical methodology; such as summary statistics, hypothesis tests, linear regression, non-linear regression, etc. Basic knowledge of medical imaging (specifically MRI) is an advantage but not necessary.

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