Medical image processing with TractoR

Jon Clayden <j.clayden@ucl.ac.uk>

useR! 2011, University of Warwick
Medical imaging

- Images from MRI, CT, X-ray, etc.; used for clinical diagnosis and prognosis, and biomedical research
- Essentially a 2D, 3D or 4D array of signal intensities
- Occasionally vector-valued
TractoR

• TractoR consists of five R packages and a shell interface

• Focus is on MRI images

• Core is the tractor.base package, which defines the main MriImage class

• This is a reference class containing the data array and some metadata:

```r
> image
  Image source : /usr/local/tractor/share/mni/brain
  Image dimensions : 91 x 109 x 91 voxels
  Coordinate origin : (46,64,37)
  Voxel dimensions : 2 x 2 x 2 mm
    Data type : unsigned integer, 8 bits/voxel
    Additional tags : 0
    Sparseness : 71.38% (dense storage)
> image[45,55,45]
[1] 98
> max(image)
[1] 207
```
Features

- Support for reading/writing MriImage objects to/from standard image formats (DICOM, Analyze, NIfTI-1, NIfTI-2, MGH)
- Ability to store image data in a sparse or dense format
- Various visualization options
- Create new images by applying arbitrary functions to other images; or by thresholding, masking, etc.
Additional packages

- `tractor.session` provides a file system abstraction, representing a set of images relating to a single subject, plus common image processing operations which are performed on sessions.

- `tractor.native` provides C code with an R interface, for expensive functions such as diffusion MRI-based “fibre tracking”.

- `tractor.nt` provides a demonstration implementation of “neighbourhood tractography”, an approach to white matter segmentation in the brain.

- `tractor.utils` exists primarily to support the shell interface.
Resources

- Forthcoming paper on TractoR in *J Stat Softw* special volume on Magnetic Resonance Imaging in R
- Full TractoR source code and high-level documentation available at [https://github.com/jonclayden/tractor](https://github.com/jonclayden/tractor)
- The `tractor.base` package is on CRAN (plus [RNiftyReg](https://cran.r-project.org/web/packages/RNiftyReg/index.html) for image registration)
- TractoR version 2.0 recently released
- See also the medical imaging task view on CRAN