

Medical Image Analysis Using S4 Classes/Methods

An Update

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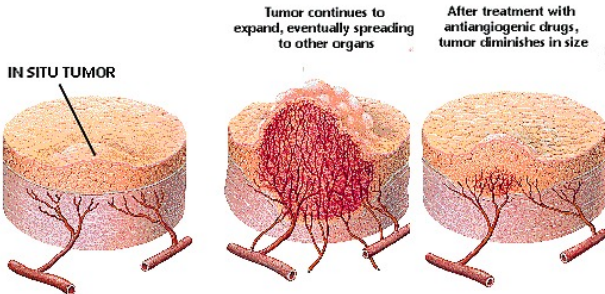
08 March 2011



Outline for Tonight

- Imaging biomarkers for oncology
- Magnetic resonance imaging (MRI)
- Dynamic contrast-enhanced MRI
- R package **dcmriS4** with dependencies
- Live Demo!

Imaging Biomarkers for Oncology



Imaging Biomarkers for Oncology

- The characterization of perfusion in tissue is a useful endpoint in clinical trials for drug development.
 - Angiogenesis
 - Blood-brain-barrier integrity
- Imaging techniques may be used to assess perfusion non-invasively.
- The characterization of diffusion in tissue has become a popular tool.

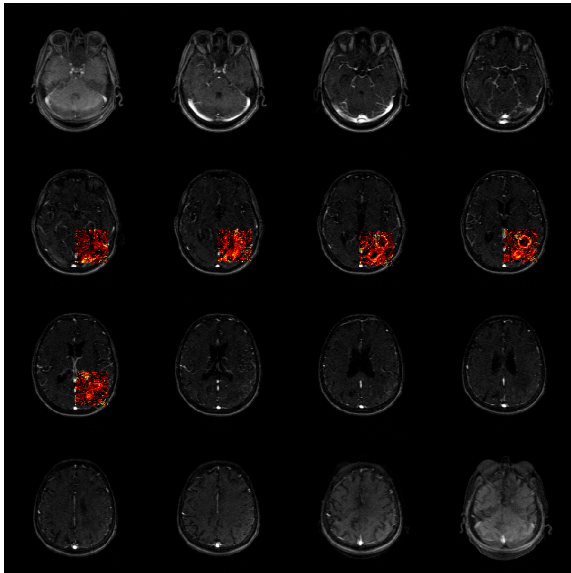
Magnetic Resonance Imaging



Magnetic Resonance Imaging

- A constant, homogeneous magnetic field (the B_0 field) is used to polarize spins.
- The exposure of nuclei to a radio frequency (RF) pulse (the B_1 field) at the Larmor frequency causes the nuclei in the lower energy state to jump to the higher energy state.
 - Macroscopic level: this causes net magnetization to spiral away from the B_0 field.
 - After time, the magnetization vector becomes perpendicular to the main B_0 field.
- MR imaging is based on the relaxation that takes place after the RF pulse has stopped.
- It is repeated for many different levels of phase encoding to build up a matrix in k -space.
- A 2D Fourier transform is performed, resulting in a single slice from an MRI acquisition.

Dynamic Contrast-Enhanced MRI



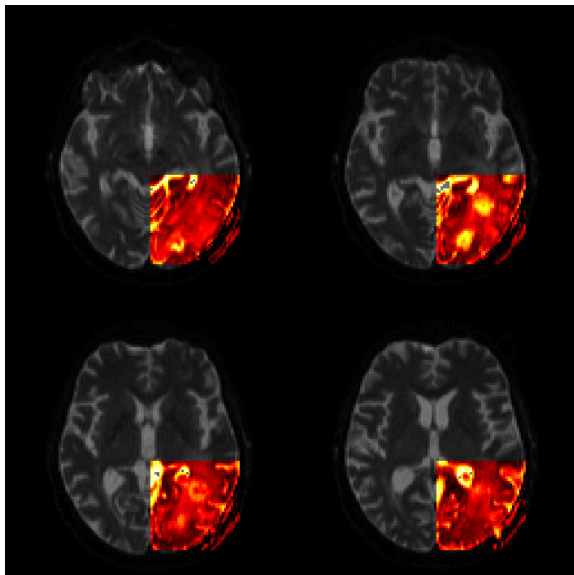
Dynamic Contrast-Enhanced MRI

- The quantitative analysis of DCE-MRI involves fitting pharmacokinetic models to the concentration of a contrast agent over time.
 - Gadolinium-based contrast agents are injected after several baseline scans.
 - Using T1-weighted sequences, the reduction in T1 relaxation time caused by the contrast agent is the dominant signal enhancement.
- T1-weighted kinetic curves have three major phases
 - the upslope
 - maximum enhancement
 - washout

$$C_t(t) = v_p C_p(t) + K^{\text{trans}} [C_p(t) \otimes \exp(-k_{\text{ep}}t)]$$

- **dcemriS4** provides all stages of data analysis for DCE-MRI using S4 `nifti` classes/methods.

Diffusion-weighted Imaging



R Package **dcmriS4**

- **Title:** A Package for Medical Image Analysis (S4 implementation)
- **Description:** A collection of routines and documentation that allows one to perform voxel-wise quantitative analysis of dynamic contrast-enhanced or diffusion-weighted MRI data.
- **Depends:** R ($\geq 2.6.0$), grDevices, graphics, methods, oro.nifti, utils
- **Suggests:** bitops, minpack.lm, multicore, splines, XML
- **License:** BSD
- **URL:** <http://www.dcmri.org/>

sourceforge



Live demo!

Thank-you for your attention!