The Steiner Suite Spin-Echo MRI Contrast Simulator

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Introduction

The contrast simulator is a small GUI created with GUIDE in MATLAB 2017b, designed to generate synthetic images from M_o, T_1 and T_2 maps.

It is available as a function, to be run from the MATLAB IDE:

pft_ContrastSimulationGUI.m

Also, as a standalone executable, which may be run on any PC, with or without a working installation of MATLAB (possibly after download of the appropriate MATLAB Compiler Run-Time):

MRI_SE_Contrast_Simulator.exe

The inputs to the application are sample parameter maps acquired using the Siemens MR Fingerprinting WIP, stripped of all patient-identifying information using DicomCleaner and pickled into MATLAB data files (ABC.mat). Conceivably, other inputs could be used, with a simple adaptation of the code. In future, the interface might also be extended to create synthetic FLASH images with variable TR, TE and flip-angles.

The GUI has been written as a programming exercise, although it is already proving useful as a way to validate the MRF protocol. It could also be helpful to radiographers to plan their scans, working in either of two directions:

1. ***"Given these parameters (TR/TE), what should the images look like ?"***
2. ***"If I want my images to look like this, what parameters should I use ?"***

Controls and Parameters

a. The File menu.

- Open Data Set: Self-explanatory.

- Save Results: Options are set in the Export group box.
  Individual slices or whole stacks may be saved.
  DICOM stacks of the synthetic weighted images may be produced.

  Results are written in a sub-folder matching the name of the i/p data.
  Fresh outputs are numbered to avoid over-writing earlier ones.

- Import Parameters: From a numbered XLSX file.
  Browsing will begin from a Results sub-folder matching the i/p data, unless no parameters have yet been saved for that study, in which case you will need to browse among other folders from one or two levels up.

- Save Parameters: In a numbered XLSX file.

b. The main display area.

- 4 image panes: From left to right, the M_o, T_1 and T_2 maps, and the synthetic weighted image.
- Display controls: Upper and lower window levels, and selectable colormaps. A common slider control.

c. Image Weighting.

- Custom: Controlled from the TR and TE sliders.
- Proton Density: TR/TE = 5000/5 ms.
- T1W: TR/TE = 100/5 ms.
- T2W: TR/TE = 5000/50 ms.
- Mixed: TR/TE = 300/50 ms.

d. Sequence Parameters.

- TR: In ms.
- TE: In ms.
- Noise: In per cent of the peak magnitude time-domain signal.

  The synthetic image is calculated immediately for the current slice, and sliders can be dragged to produce a continuous and immediate response.

- Reset Windowing: To program defaults.

e. Export.

- Map slices: Axes screenshots in PNG format.
- Map stacks: TIFF, generated by animating the slider through the image slices.
- WI slice: Axes screenshot in PNG format.
- WI stack: TIFF, generated by animating the slider through the image slices.
- WI DICOM stack: Generated by animating the slider through the image slices.

f. Captions.

These may be switched on or off, and the colour can be selected from a rainbow palette.