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1. Overview

ADCmap is a software utility and graphical user interface to reconstruct apparent-diffusion-coefficient (ADC) maps from diffusion-weighted acquisitions with an MR Solutions preclinical MRI system.

Note: the program calculates does not calculate a diffusion tensor, but only estimates the mean diffusivity / ADC.

2. Contact

ADCmap and this manual are written by:

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3. Disclaimer

The software has been extensively tested using mouse and rat data acquired with an MR Solutions preclinical 7.0T/24cm system.

However, this does not warrant the functions contained in the program will meet your requirements or that the operation of the program will be uninterrupted or error-free.

In case of questions or issues, please contact Gustav Strijkers or Bram Coolen.

4. Installation notes

Software download

Matlab source code and a Windows standalone version (using the free Matlab runtime engine) can be downloaded from github:

https://github.com/Moby1971?tab=repositories

Installation of the Windows standalone version

MyAppInstaller_web.exe

Will install the Matlab runtime engine and the ADCmap program.

5. Running the software

Running in Matlab 2020a

The ADCmap software can be started from its root directory from the command line.

>> ADCmap

Notes:

Additional licenses may be required.

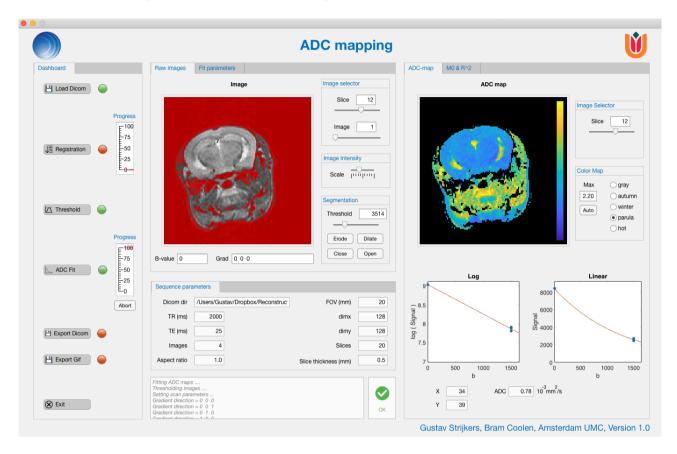
```
>> license 'inuse'
distrib_computing_toolbox
image_toolbox
map_toolbox
matlab
neural_network_toolbox
```

Running the Windows standalone

The Windows standalone version can be run from the start menu or the desktop icon.

6. Basic operation

The ADCmap program operates from a single window with 5 panels.



Panel 1: Dashboard

This panel contains the task buttons and parameters that control the reconstruction process. The dashboard tasks need to be completed from top to bottom. A green light next to the task indicates that the task has been completed. Red indicates not completed yet.

Panel 2: Raw images & fit parameters

This panel has 2 tabs, raw images and fit parameters.

Panel 3: Scan parameters

This panel displays the relevant acquisition parameters.

Panel 4: ADC-map, M0 & R2

During and after fitting is completed this panel shows the fitted ADC-maps. M0-maps and R² goodness of fit maps are displayed in the second tab.

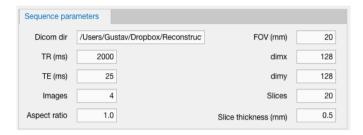
Panel 5: Messages

Displays program status and messages.

Step 1: Loading data

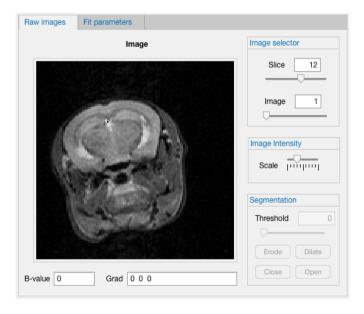
Press Load Dicom to import load the Dicom files with the diffusion-weighted images.

Relevant acquisition parameters will be shown in panel 3.



Step 2: Image registration

Use the sliders and/or edit-fields to inspect the slices and images (b-values / diffusion-directions combinations). The image scale can be adjusted with the Scale slider.



In case the images not perfectly registered, press 🗏 Registration to perform an affine registration which includes translation, rotation, and scale.

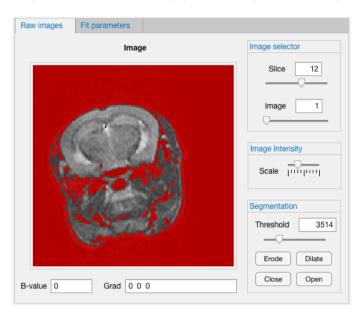
NOTE: this step usually can be omitted.

Step 3: Segmenting the images

To prevent unnecessary fitting of the background pixels, the images need to be segmented first.

Press Threshold to perform an automatic thresholding segmentation.

The result will look something like the figure below in which the red pixels indicate the regions that will be skipped during ADC fitting.



In case automatic thresholding is not optimal, the threshold can be manually adjusted per slice. The segmentation can be optimized by erode, dilate, close, and open morphological operations.

Step 4: Fitting ADC maps

Press the Fit parameters tabs to inspect some fit settings.



The first and last slice that will be fitted can be selected.

When the threshold box is selected, min R-square indicates the minimal R² value that is accepted after fitting.

Note: If multiple gradient directions are used and tissue diffusivity is anisotropic R² is not a good measure for the goodness of fit, because it will include variations due to the directional anisotropy.

The bottom part of this tab shows a list of all the images (b-values and diffusion-direction combinations). The images that are selected will be included in the fitting process. This option can be used to exclude certain images.

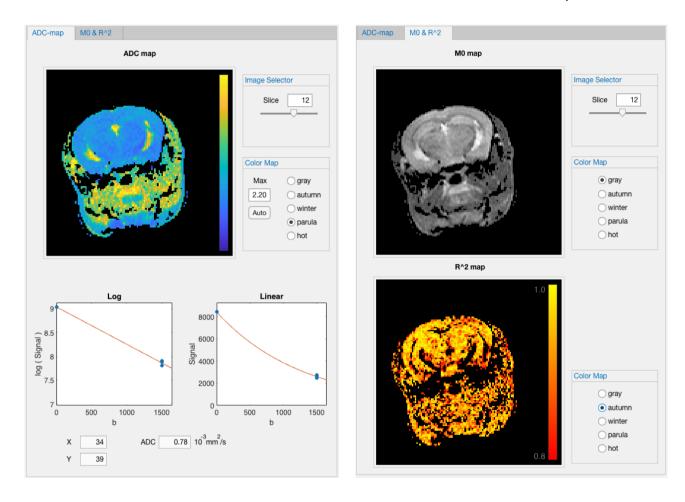
Press ADC Fit to start the ADC fitting.

Fitting will be done using a least-squares algorithm according to the equation Signal = M0 exp(-b·ADC)



Step 5: Fit results

The ADC maps will be shown in the ADC-map tab. An M0 map and R² map are shown in the second tab. A different color scheme can be chosen for the different maps.



Click on the ADC map with the mouse cursor to display log(Signal) and Signal as function of b-value (symbols) and the fit result (red lines). The fitted ADC in the pixel is shown below the plots. A red symbol indicates that this b-value/diffusion-direction was omitted in the fitting process, according to the list in the Fit parameters tab (see step 4).

Step 6: Exporting the ADC maps

There are two ways to export the ADC, M0, and R2 maps.

(1) Export Dicom Export Dicom

Exports the data in Dicom format for further processing in 3rd party software.

(2) Export Gif Export Gif

Exports the data in Gif format.

Step 8: Exit

Press 🕲 Exit to shut down the program.