Artifact Detection Tool

This is a graphic tool for automatic and manual detection of global mean and motion outliers in fMRI data. The zip / tar.gz files include the tool's Matlab source files and documentation. The tool is also available as part of our brain imaging toolbox. To install, simply extract the files and place them somewhere in your matlab path.

MATLAB (tested with 7.2, but probably works with earlier versions) and SPM2/SPM5 are required. The artifact tool reads Analyze (.img) and NIFTI (.img/.nii) format images. Motion parameters can be specified either as .txt files (SPM) or .par files (FSL).

The software was developed by Shay Mozes and Susan Whitfield-Gabrieli in the Gabrieli lab at MIT based on a previous tool by Paul Mazaika, Susan Whitfield, and Jeffrey C. Cooper.

Usage:

To call the utility, simply type "art" in Matlab.
The utility asks for image files and a text motion parameters file. It then displays four graphs:
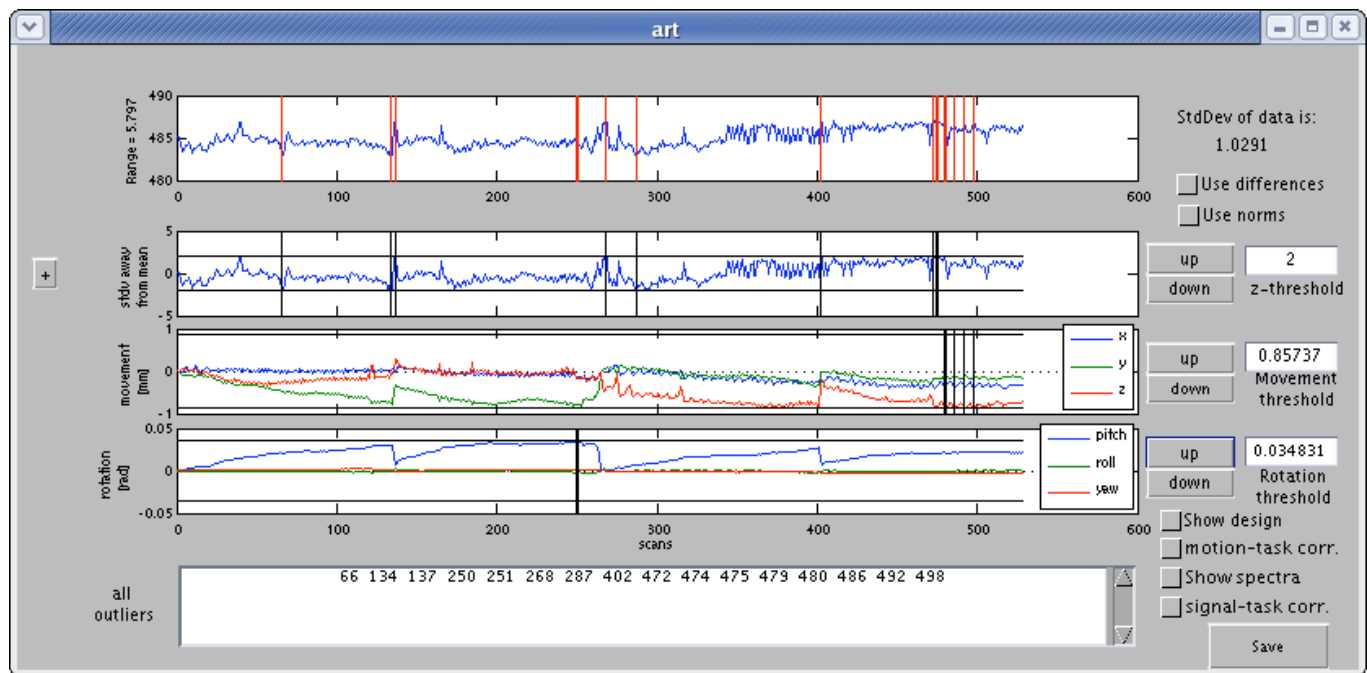
- The top graph is the global brain activation mean as a function of time.
- The second is a z-normalized (stdv away from mean) global brain activation as a function of time.
- The Third shows the linear motion parameters (X,Y,Z) in mm as a function of time
- The fourth shows the rotational (angular) motion parameters (roll,pitch,yaw) in radians as a function of time.

Using default threshold values for each of the bottom three graphs we define outliers as points that exceed the threshold in at least one of these graphs. The thresholds are shown as horizontal black lines in each of the graphs.
Points which are identified as outliers, are indicated by vertical black lines in the graphs that correspond to the outlying parameters. For example, the if the absolute value of the Y motion parameter for time t=17 is above the motion threshold, it is identified as an outlier

and indicated by a vertical line at t=17 in the third graph. The union of all outliers is indicated by vertical red lines on the top graph. The list of outliers is also displayed in the editable text box below the graphs. The current values of the thresholds are displayed by the side of the corresponding graphs. These values may can be changed by the user either by pressing the up/down buttons, which increment/decrement the current value by 10%, or by specifying a new value in the text box.

By checking the "Use Differences" checkbox, you can identify outliers in the temporal difference series, rather than the original motion parameter values. Note that there are different thresholds for the difference series and that you can toggle back and forth between the two modes. You can threshold the norms of the linear motion parameters and of the angular motion parameters (instead of each parameter individually) by checking the "Use norm" checkbox.

In Addition, the user can manually add or remove points from the list of outliers by editing the list. Note that the list is only updated once the cursor points outside the text box (i.e. click the mouse somewhere outside the text box). Since any changes made by the user are overridden once the thresholds are updated, it is recommended to do any manual changes as the last step before saving. Pressing the save button lets the user choose whether to save the motion statistics (.mat or .txt) the list of outliers (.mat or .txt), or save the graphs (.jpg, .eps or matlab .fig).

The "Show Design" checkbox. When this checkbox is checked, the task conditions from the design matrix are superimposed on the z-normalized graph. This might help identify correlations between the motion or the task and the experimental design. This design matrix is obtained from an SPM.mat file specified by the user. This is show below. pressing the small '+' button on the left side of the z-graph will plot it in a separate window (also shown below).
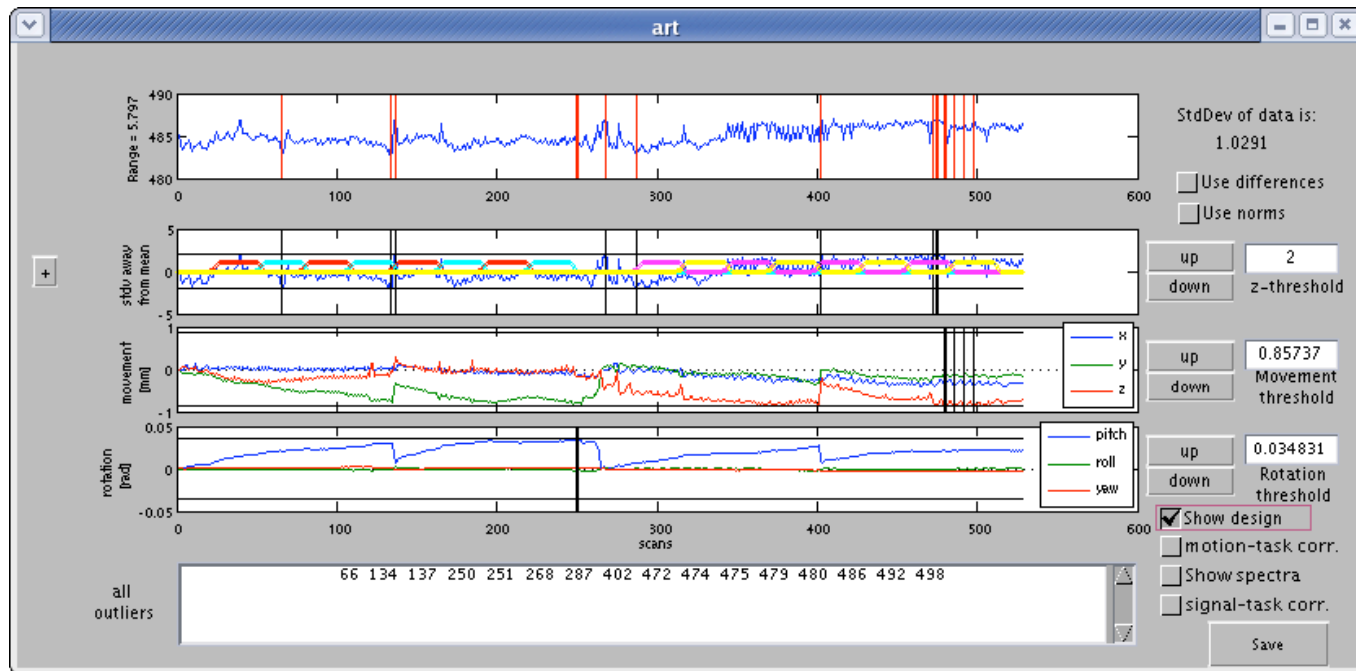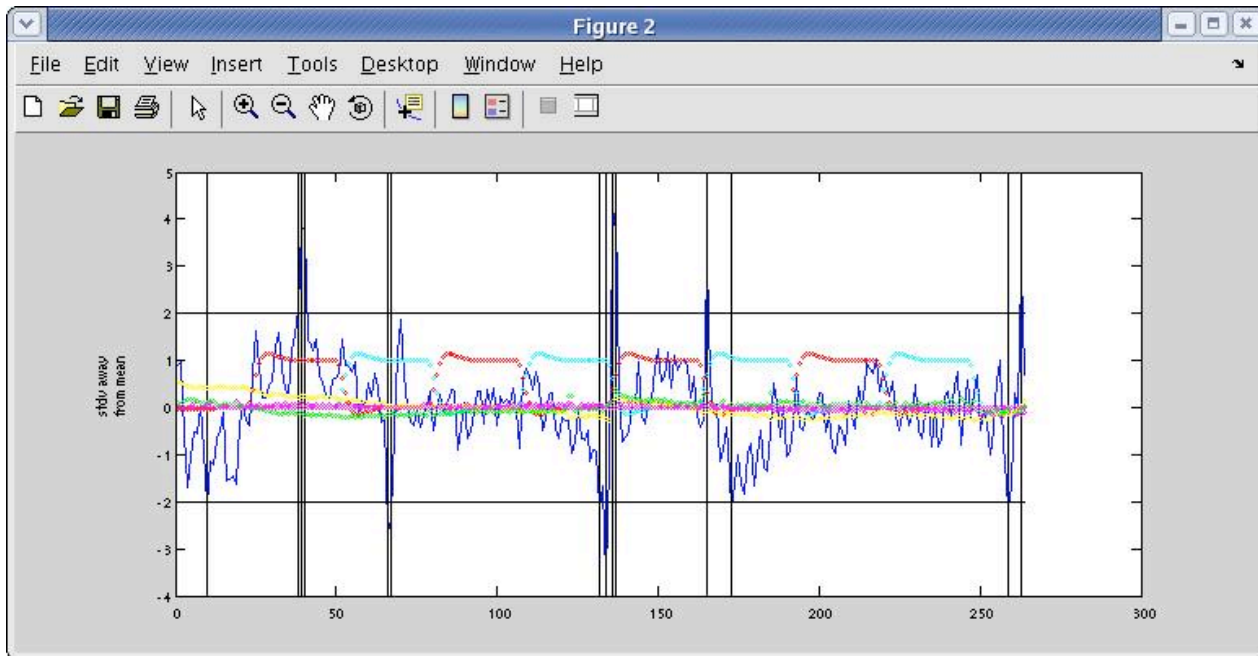
The "motion-task corr." checkbox displays in a new window an intensity map of the correlations between the task conditions and motion parameters for each session. Note: It is far better to use a design matrix where the motion parameters are not considered as covariates, since the motion parameters are shown anyway.

Similarly, the "signal-task corr." checkbox displays in a new window an intensity map of the correlations between the global signal and task conditions for each session.
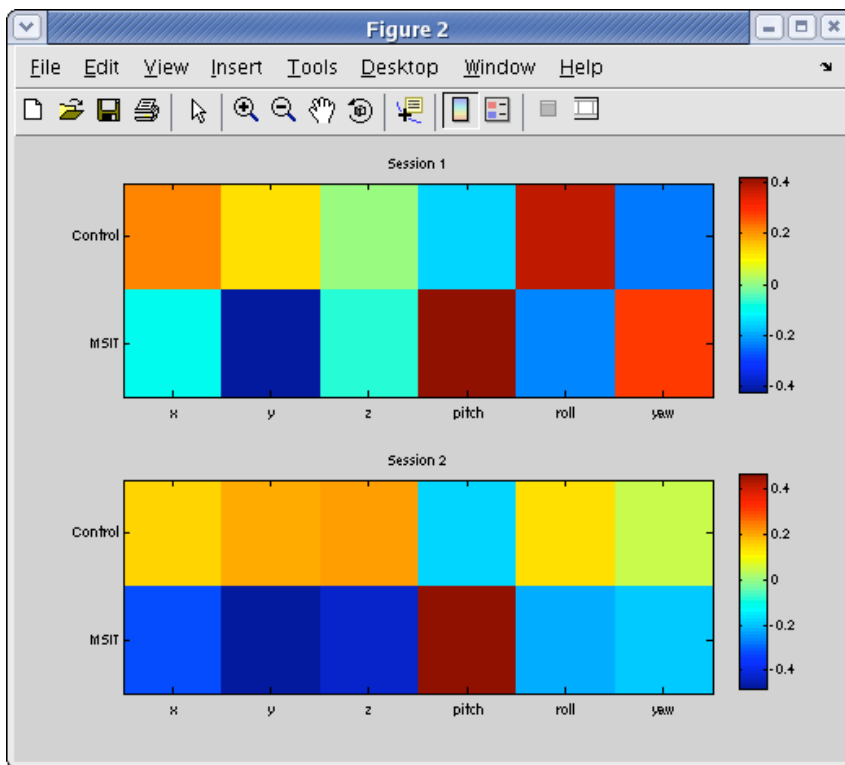
The "Show Spectrum" displays the power spectrum of the task conditions and motion parameters in a new window (each session has its own graph). The highpass cutoff frequency is also displayed. The user may choose which parameters to display by

(un)checking the appropriate checkboxes. Note: It is far better to use a design matrix where the motion parameters are not considered as covariates, since the motion parameters are shown anyway.
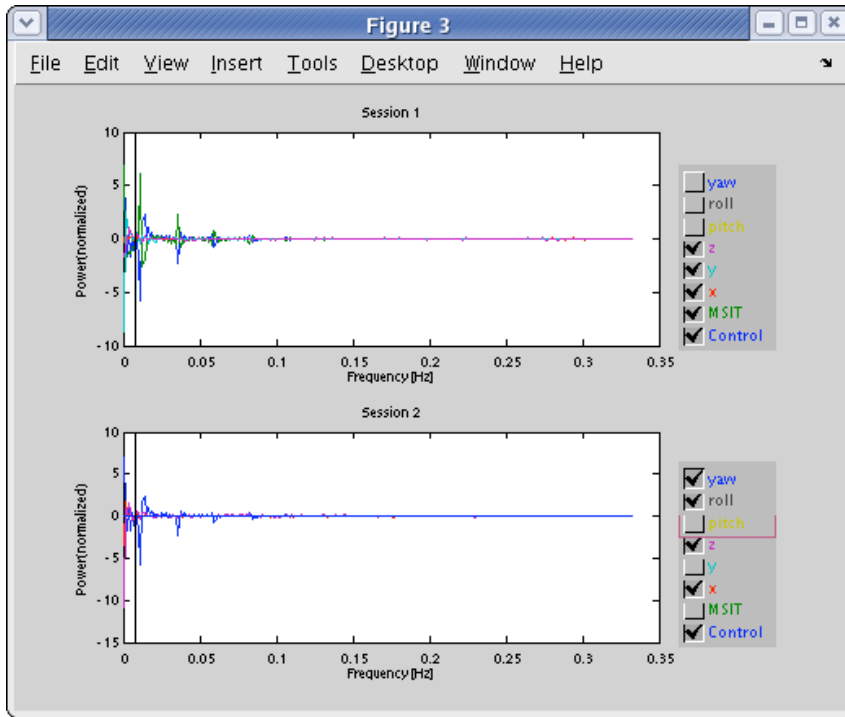
Please report any bugs or needed improvements to Susan Gabrieli (swg@mit.edu).