Software for the Visualization of fMRI Data

A. Mockus, W. F. Eddy, S. Y. Chang,
K. R. Thulborn

Objective

- Reliable detection
- of activation regions
- in the human brain
- using fMRI

Issues

- Noise
  - Large
  - non-stationary in
    - space
    - time
  - non-homogenious

Solution

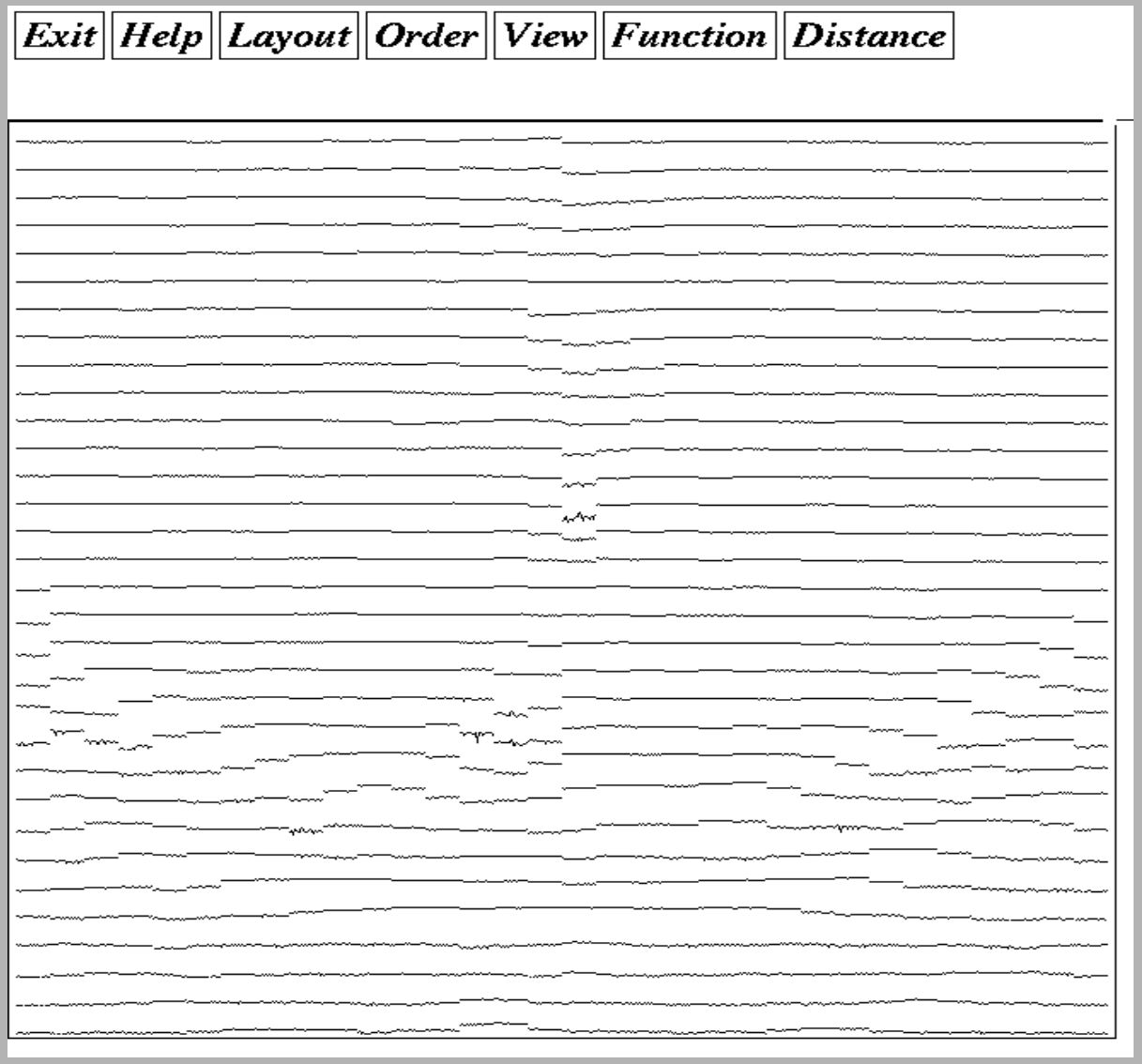
- System for
  - Visual
  - Interactive
  - Quantitative
- Analysis of
  - large datasets of fMRI images

How

- Simultaneous display of:
  - All images in the sequence
    - To identify/remove bad images
  - All locations (voxels) over time
    - To identify unusual voxels
    - To identify active voxels with regard to similarity between:
      - time series of intensity
      - time series of stimulus

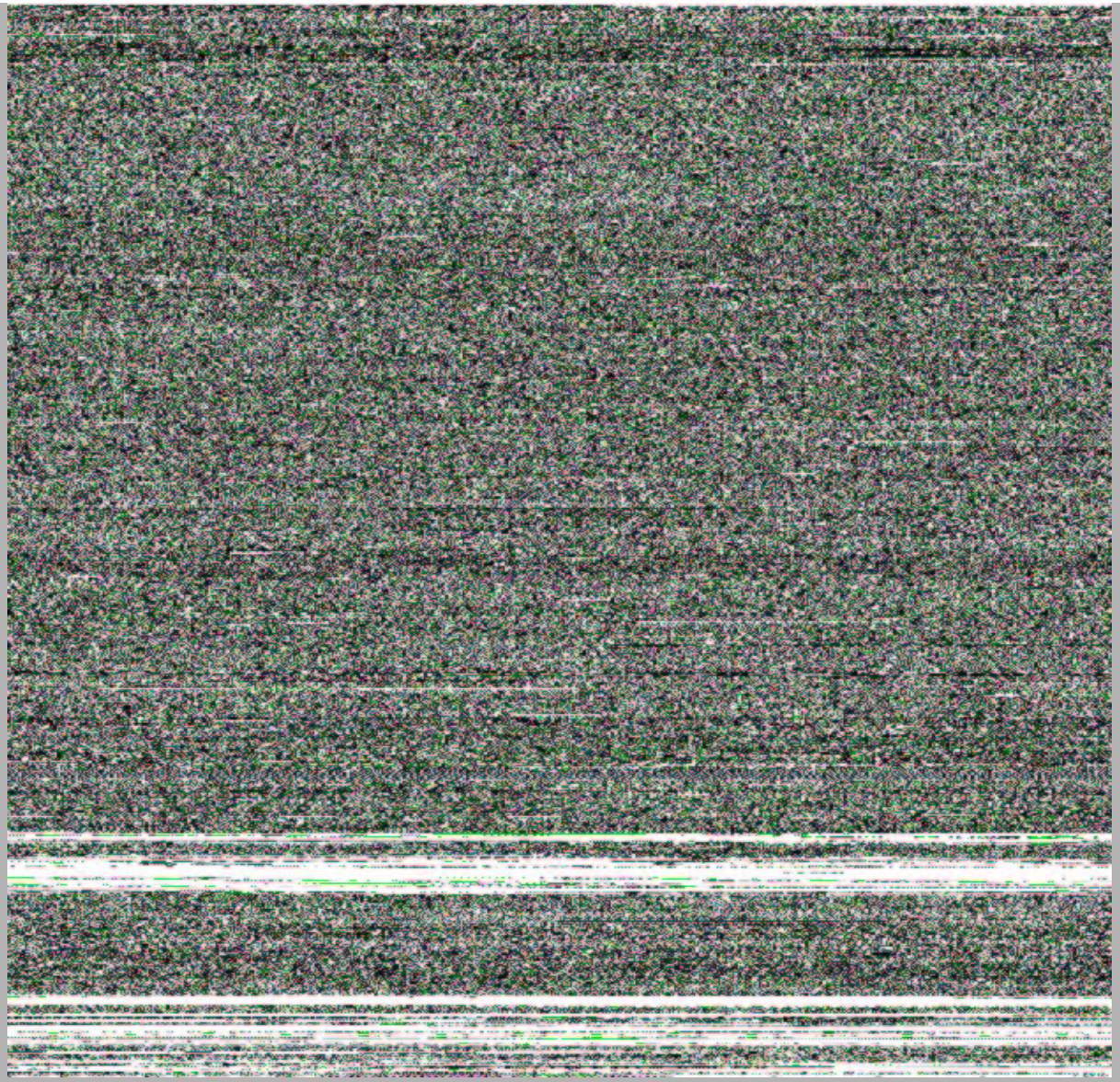
Primary Visual Study Example

- 8Hz Flashing Hemifield Checkerboard
- alternated with central fixation
  - 15s fixation
  - 15s right hemifield
  - 15s fixation
  - 15s left hemifield
- Repeated 5 times for a total 300 four slice images over 5 minutes

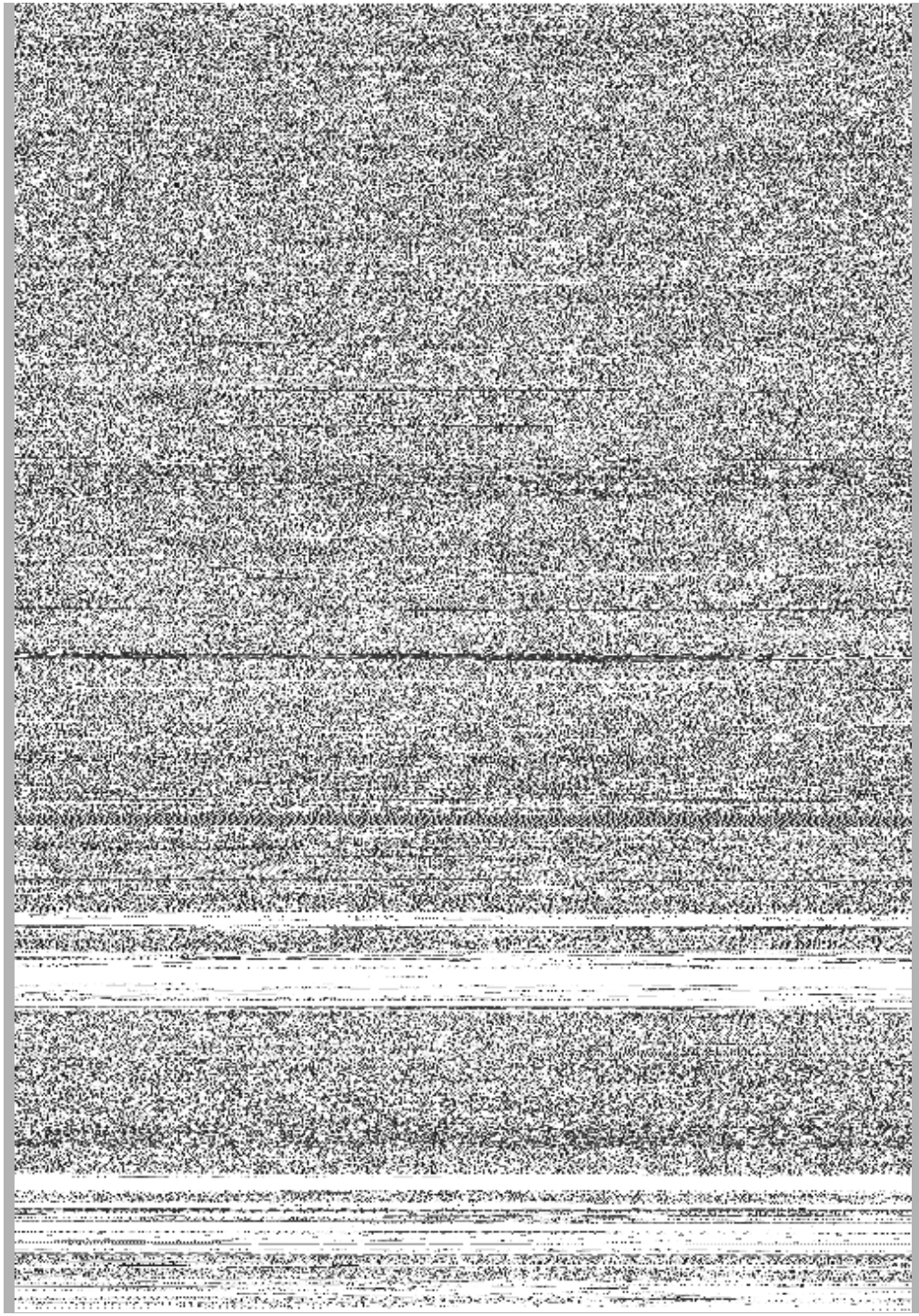


A grid of 32 by 32 time series plots for the voxels of the second axial slice of occipital lobes demonstrates different strength of signal (high - means strong) and different amount of noise (more up-down movement means more noise). All time series plots use the same scale.

A grid of 32 by 32 time series plots for the voxels of the second axial slice of occipital lobes demonstrates different patterns of signal. Some examples are highlighted. All time series plots use the use individual scale.



A grid of 32 by 32 image coded time series plots for the voxels of the second axial slice of occipital lobes demonstrates different periodicity of signal. Many images have alternating light and dark bands corresponding to alternations of high and low signal for the particular voxel. Most banded images have five light and five dark bands each corresponding to one experimental condition.



A view of 300 images (each representing residual from the average image) for the second axial slice of occipital lobes. Each row contains 15 (32 by 32 pixel) images corresponding to one stimulus condition.

The apparent patterns in the beginning and the end of the sequence (meaning large deviation from the mean image) demonstrate non-stationary behaviour in time. Note, that the patterns at the endo of the sequence are reverse video of those in the beginning.

There are several darker and lighter than usual images scattered along all the sequence.

Conclusions

- Simultaneous display of
  - multiple images
  - multiple locations (voxels)
- Allows quick and robust detection of anomalies
- Demonstrates
  - non-homogeneity, non-stationarity
  - of noise