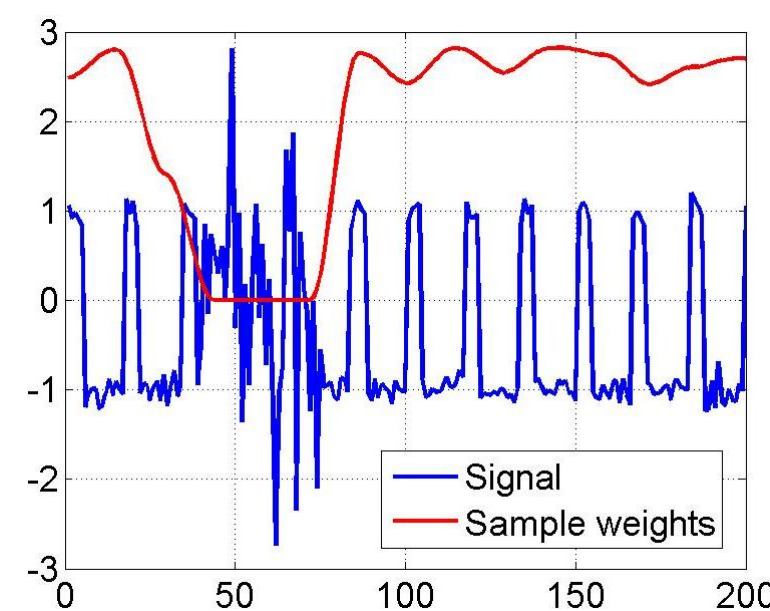


By closing the loop, fMRI is taken to a new dimension. The feedback enables stimuli which steers the brain activity towards a predefined state, e.g. that of maximum relaxation or concentration. The possibilities are many and maybe not as far away as we think.

## Theory

In realtime fMRI, short bursts of noise may have a large impact on the detection accuracy. We have developed a method for robust correlation estimation, which reduces the weight of atypical signals and thereby improves the activation detection [3].



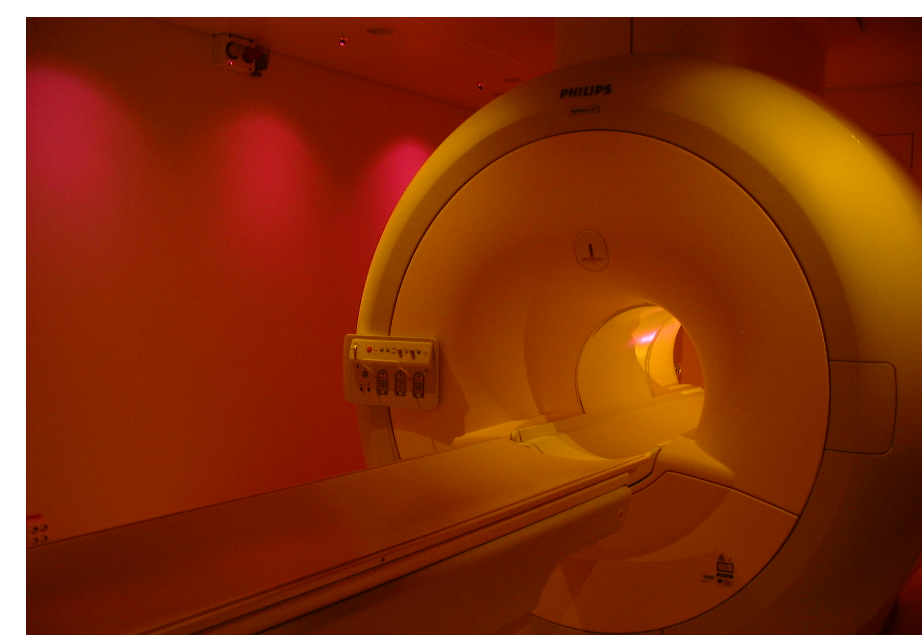
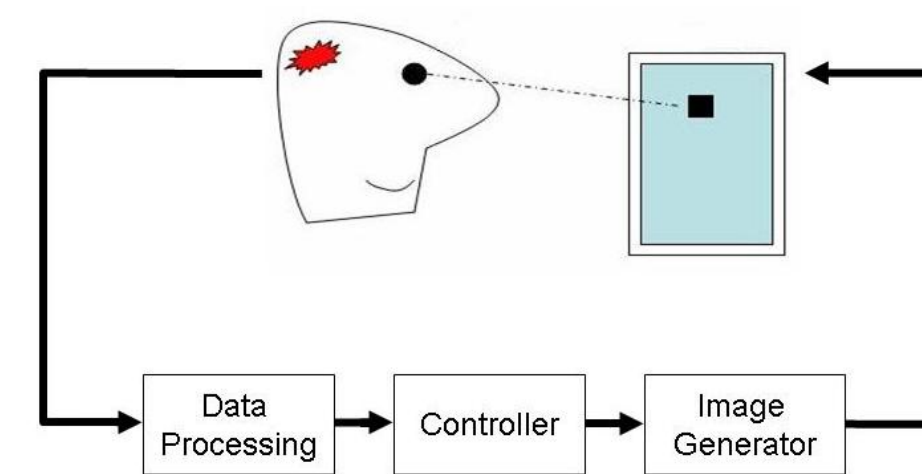
Signals of fMRI activation can be seen as points in a low-dimensional manifold embedded in  $R^n$ . The discovery and exploitation of such geometric structure in data is known as manifold learning, the new school for non-linear dimension reduction [1], [2]. We use it to solve tasks in visualization, system identification and image processing.

## Real Time fMRI and the Demonstrator

In standard fMRI, data is acquired for several minutes while the subject is exposed to pre-determined stimuli. The entire data set is then analyzed to detect active brain regions. In this project we "close the loop" and let the brain activity control the stimuli.

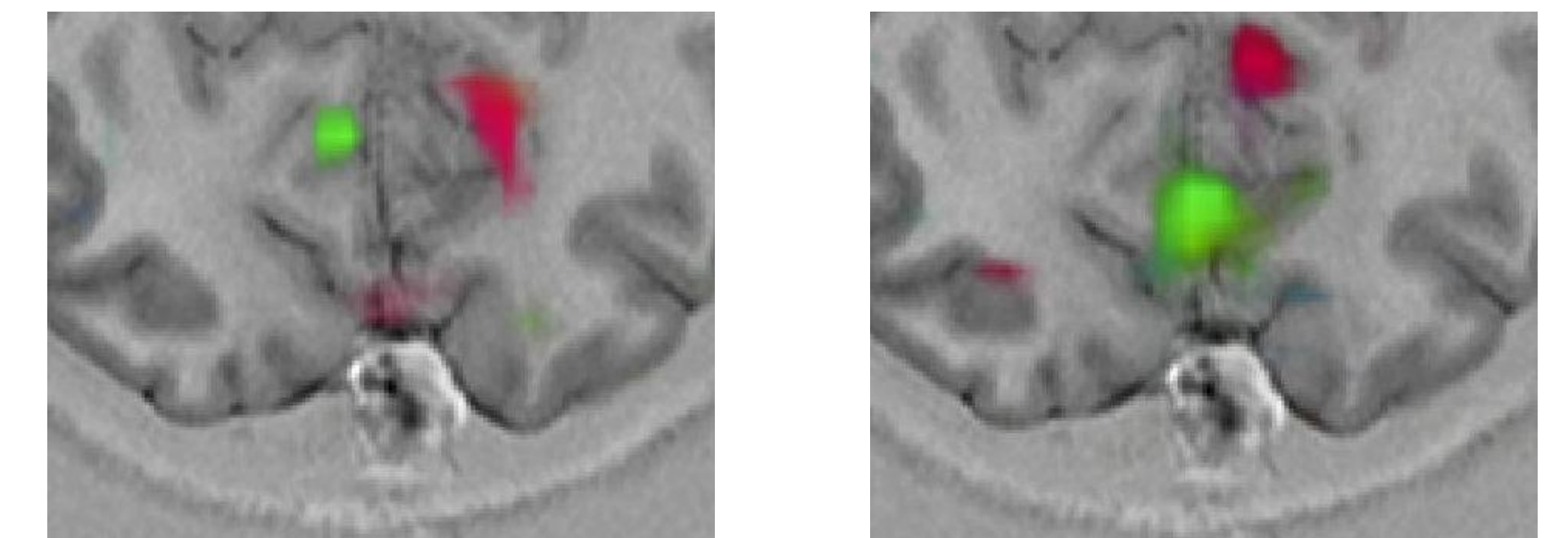
To demonstrate the concept while also gaining further insights into the workings of the brain, we will set up an experiment where a user can control a cursor using only brain activity, see [4] for a similar project. To make this possible, we need to detect brain activity in realtime.

This demonstrator poses several interesting questions regarding data acquisition, signal processing, control theory and visual representations.

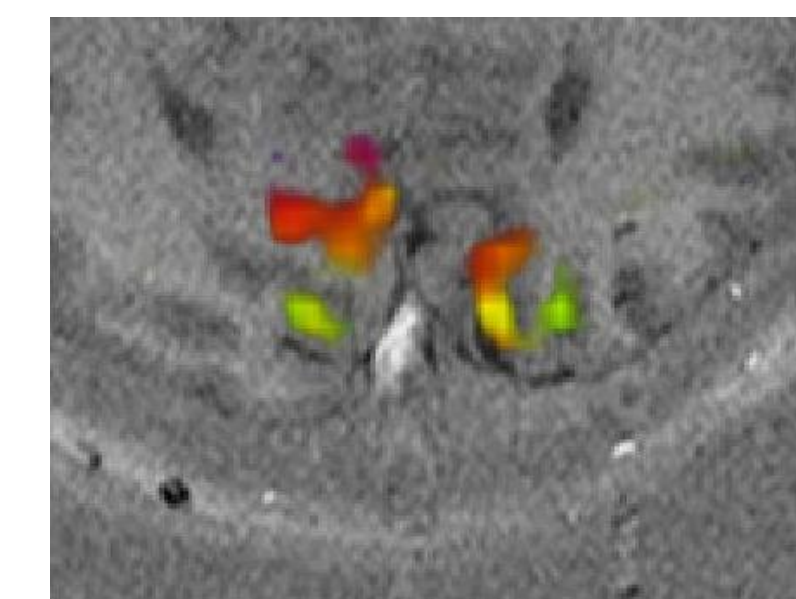


## Preliminary Results

The figures below show activation detected in the visual cortex when different parts of the field of vision are exposed to flashing stimuli.



Stimuli in different parts of the field of vision. Green: right resp. top. Red: left resp. bottom.



Shrinking circle as stimuli. The different colors represent the radii of the circle.

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