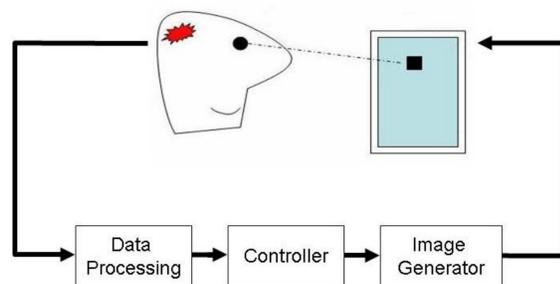


Despite the enormous complexity of the human mind, fMRI techniques are able to partially observe the state of a brain in action. In the experiment presented the system is trained to estimate where a person in the MRI scanner is looking from signals derived from the visual cortex only. We have been able to demonstrate that the user can induce an action and perform simple tasks with her mind sensed using real-time fMRI.

In standard fMRI, data is acquired for several minutes while the subject is exposed to a pre-determined stimulus. The entire data set is then analyzed to detect active brain regions. In this demonstrator 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

set up an experiment where a user can control the visual stimulus using only brain activity, see [2] for a similar project.

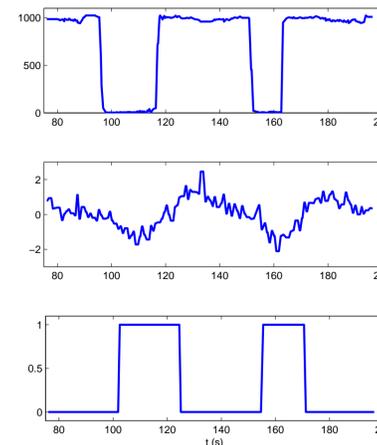


## Closing the Loop

To be able to induce a stimulus from measured brain activity, a model was first estimated based on the recordings of the response to some chosen stimuli.

The estimated model was then used in a real-time phase in order to predict where the subject was looking and to set the stimulus accordingly. Response

times down to 2.5 seconds were measured [1].



## Demonstrator Impact

We have demonstrated that the user can induce an action with her mind sensed using real-time fMRI. The technique may have several clinical applications:

- Steer the brain into pre-determined states.
- Study of activation pattern dynamics.
- Control your own pain.
- Fusion - real time fMRI and EEG.

- rtfMRI with human as (additional) controller.
- Development of aids for disabled.
- Study of effects of medication.
- Better understanding of clinical use of fMRI.

## Future

While fMRI has a high spatial resolution and a poor temporal, EEG pose the opposite qualities, poor spatial resolution but a good temporal. By combining the two brain activity measures an estimate of brain activity that has both a good spatial and temporal resolution can be obtained.

The ability to use brain activity to control a stimuli has been explored but how do you do the opposite i.e., what stimuli is needed to steer the brain into some predefined state?



## References

- [1] Ohlsson H., Rydell J., Brun A., Roll J., Andersson M., Ynnerman A., and Knutsson H. Enabling bio-feedback using real-time fMRI. In *CDC*, 2008. Submitted.
- [2] S. Yoo, T. Fairney, N. Chen, P. Choo, S. Panych, H. Park, S. Lee, and F. A. Jolesz. Brain-computer interface using fMRI: spatial navigation by thoughts. *Neuroreport*, 15:1591-5, 2004.