Event-recurring multiband SWIFT functional MRI with 200-ms temporal resolution in rat
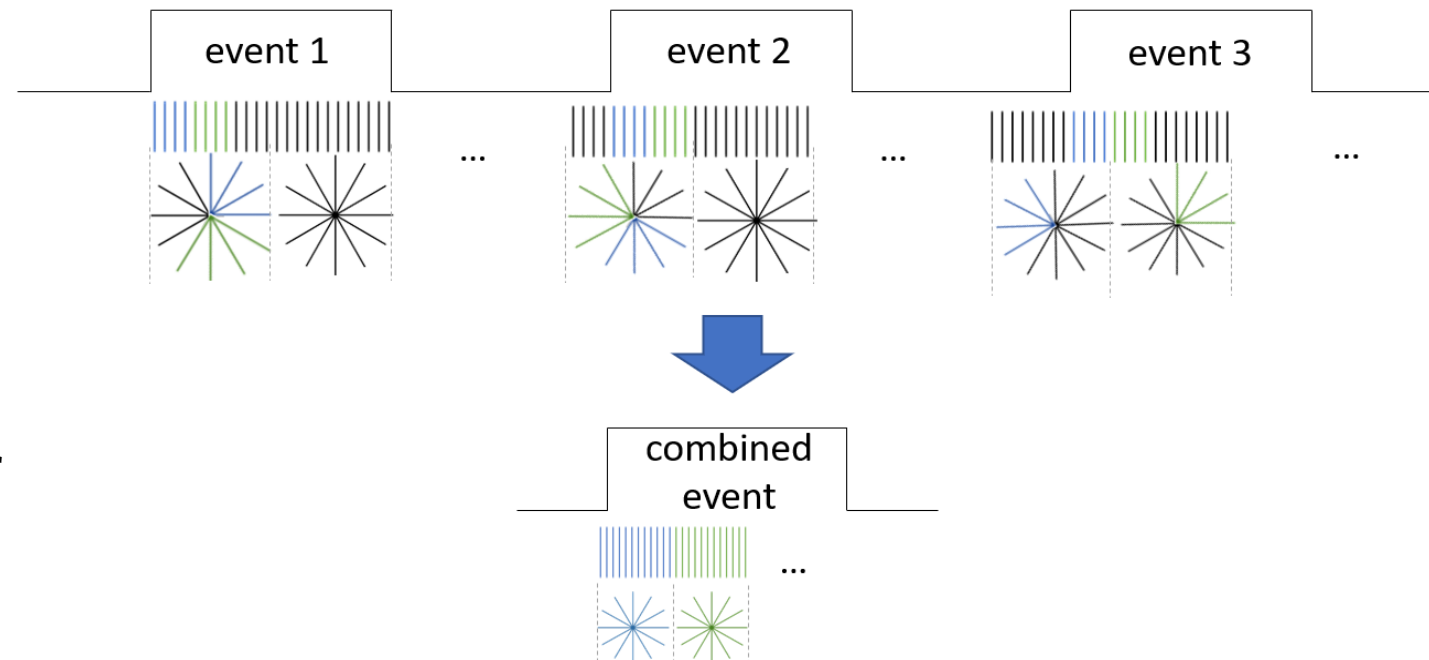
Ekaterina Paasonen, 19th Kuopio Bio-MRI workshop, 01.06.2022

- Functional magnetic resonance imaging (fMRI) suffers from low temporal resolution

- Silva and Koretsky [1] proposed a way to image repeating events with EPI sequence by exchanging phase-encoding and repetition loops

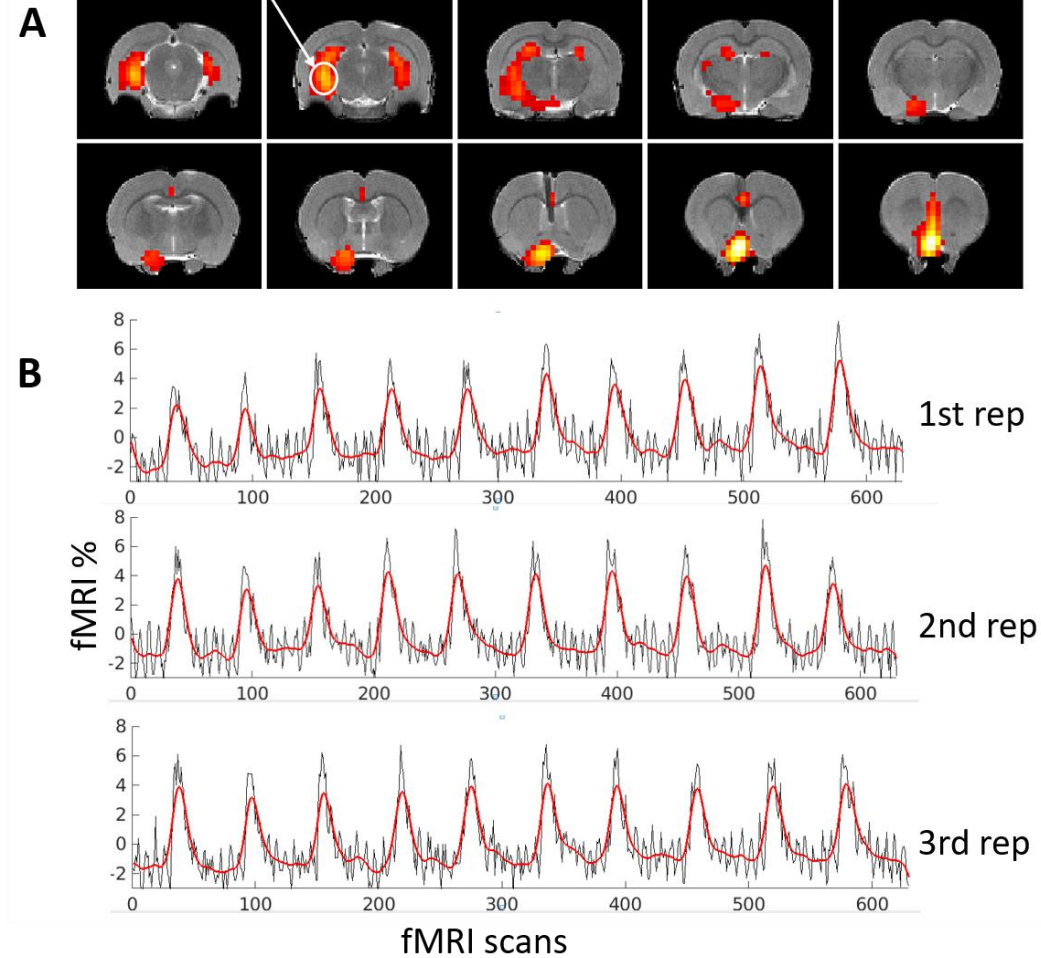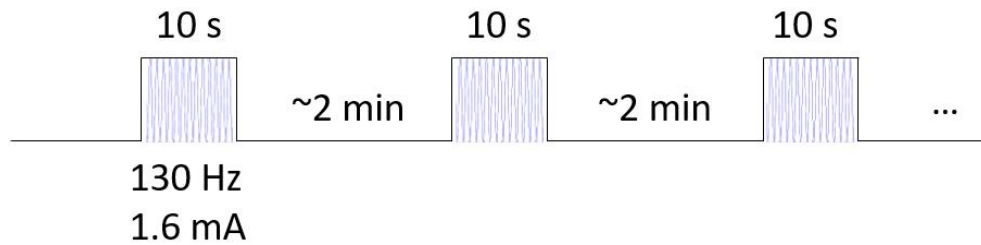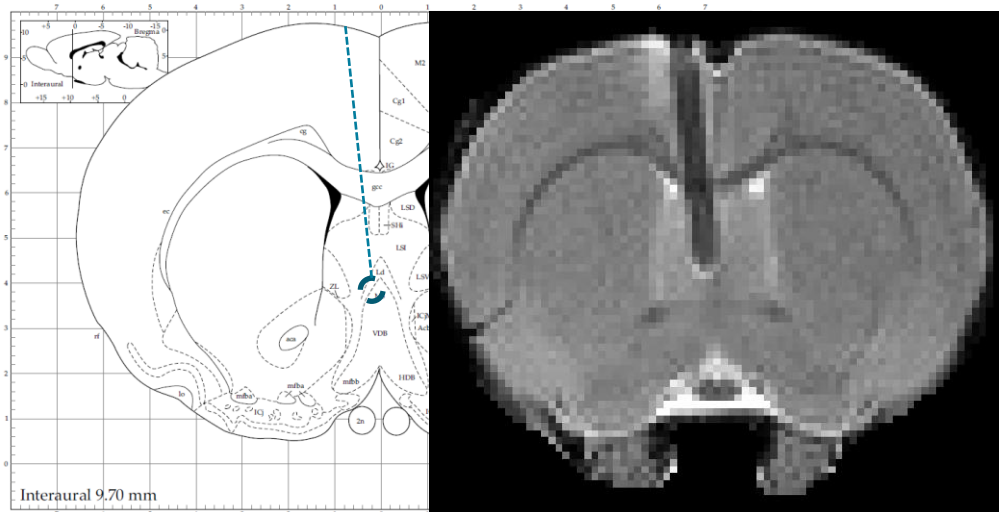*Idea of the event-repeating SWIFT (EVER-SWIFT) method:*

A small amount of spokes is collected using MB-SWIFT pulse sequence around each time point, and later they are combined from several events.


Assumption:
- The events are similar

1. Silva AC, Koretsky AP, Duyn JH (2007) Functional MRI impulse response for BOLD and CBV contrast in rat somatosensory cortex. Magn Reson Med 57:1110–1118.

DBS stimulation of the rat MSN creates stable activation -> method is applicable

10 s   10 s   10 s

~2 min   ~2 min   ...

130 Hz
1.6 mA

A

B
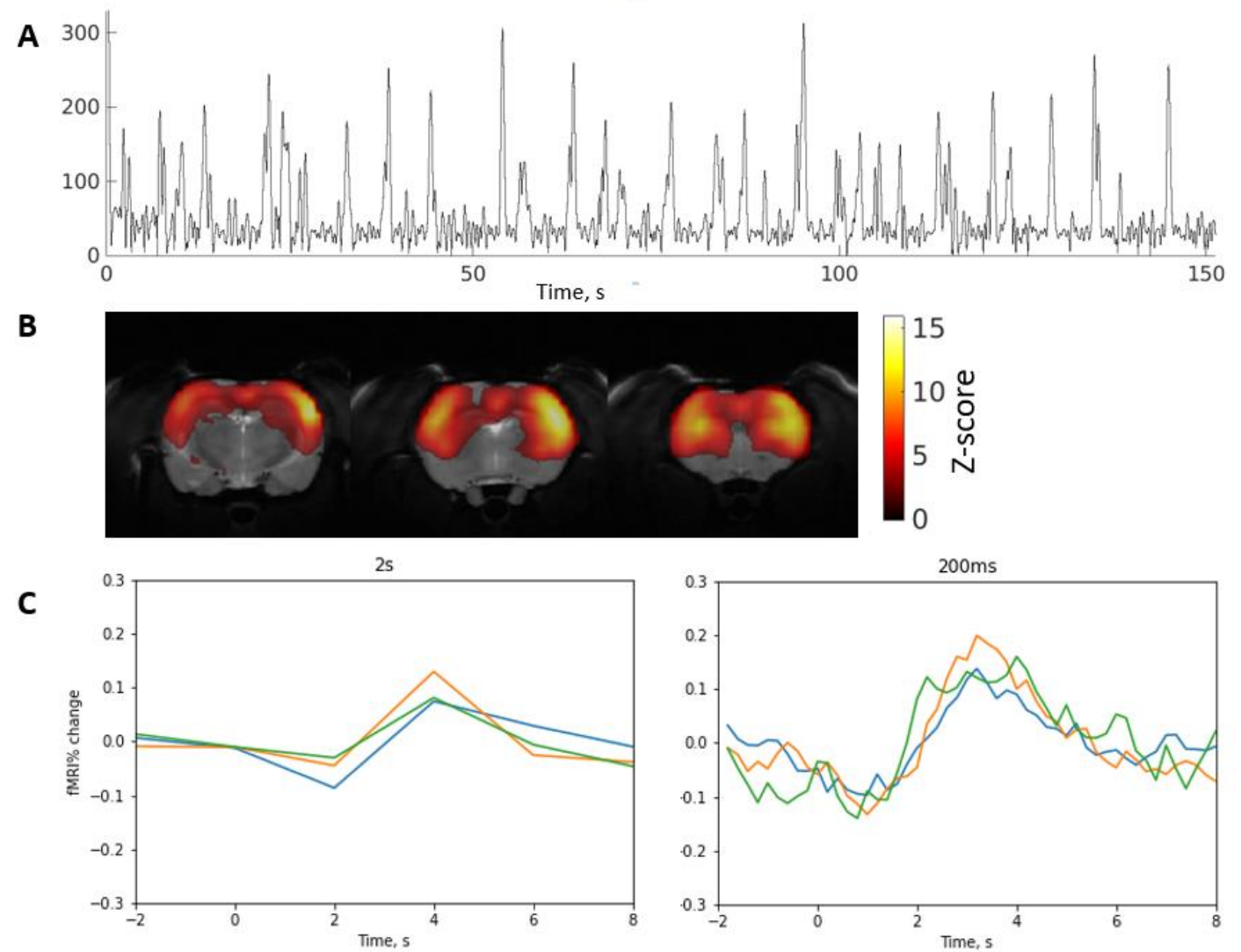

fMRI %

1st rep

2nd rep

3rd rep

fMRI scans

Activation map acquired from 2-s time resolution data and activation from the ROI.

Method is able to detect differences between time-to-peaks in the different brain areas.
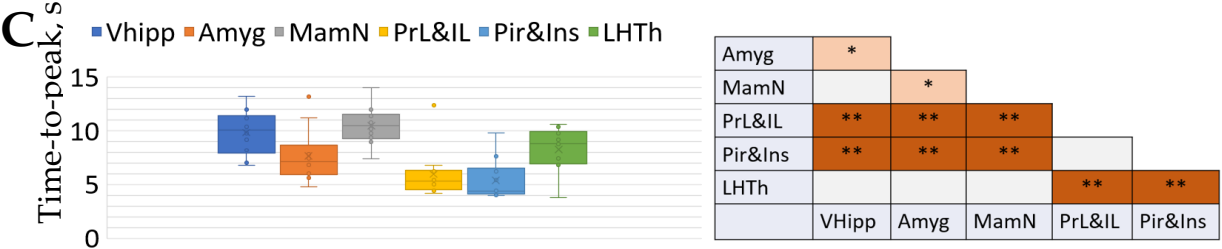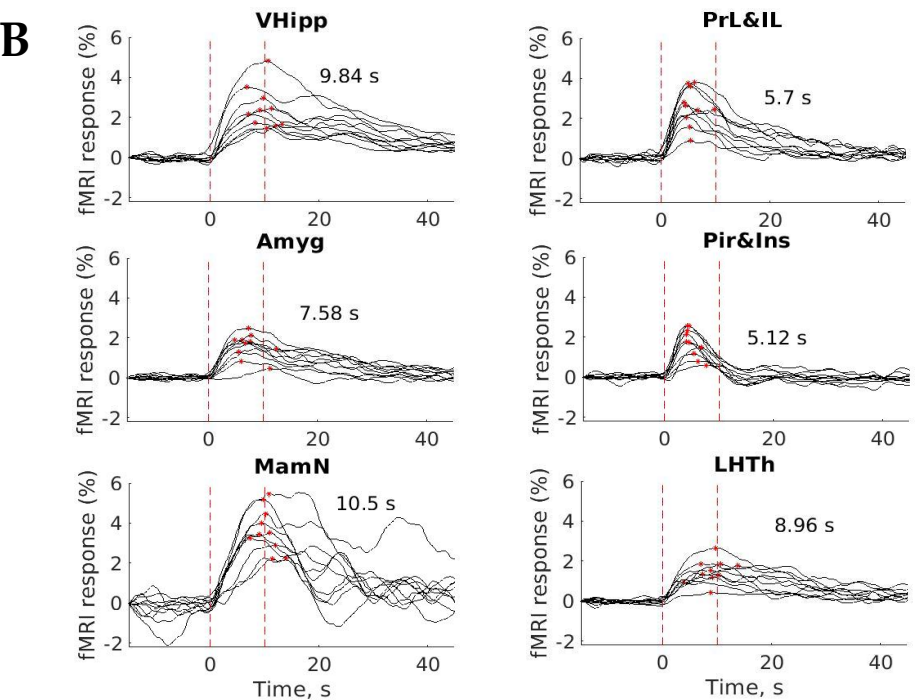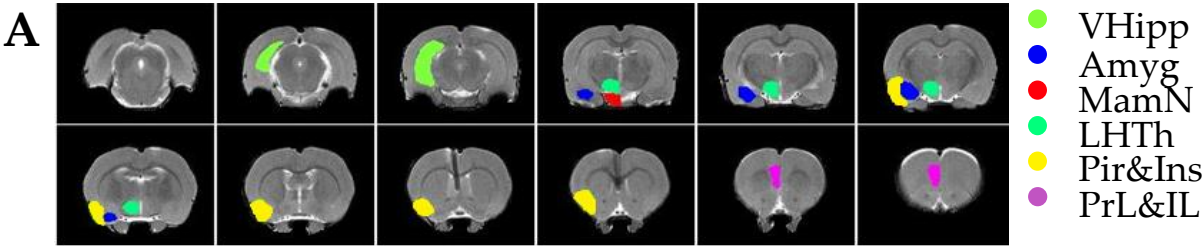
Method is able to detect activation during isoflurane burst suppression state.

A. Burst suppression EEG from a representative animal. B. ICA component related to burst suppression. C. Mean signal from 3 animals from this ICA component with 2-s and 200-ms temporal resolution.

Conclusions

- EVER-SWIFT fMRI allows for 3D imaging of **repeating events** in the brain with higher temporal resolution
- The method is easily applicable and useful for **DBS studies**, in which the responses are stable and different between brain regions.
- In addition, this method can be used for characterizing the fast dynamics of **spontaneously recurring events** with superior accuracy compared with conventional, low time-resolution approaches.

Thank you!

uef.fi