Maze Exploration In Virtual Reality

Machine Learning Approaches For The Combined Measurement Of Brain And Body

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RISE 2018 Heidelberg Summit
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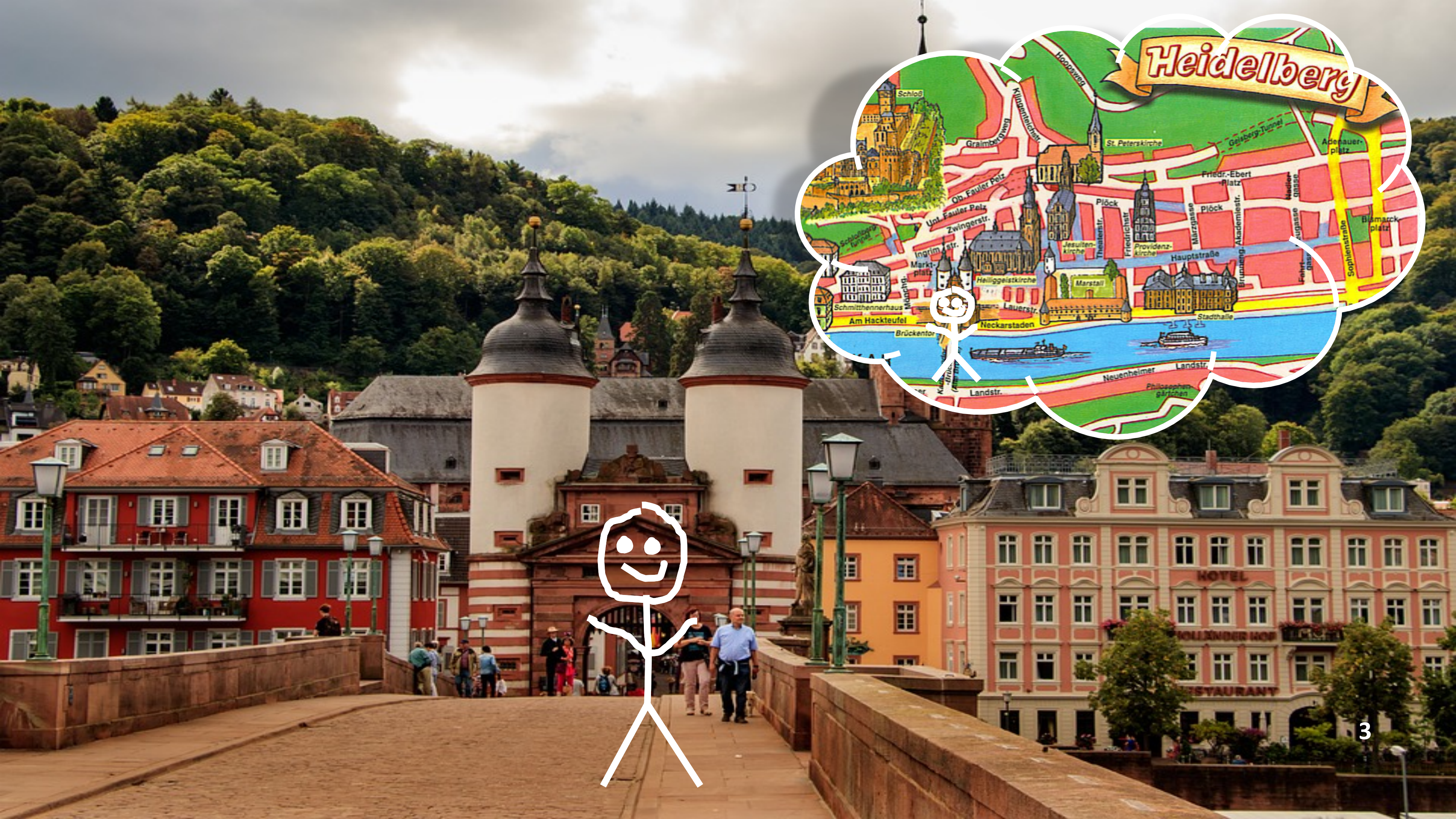
BeMoBIL
Berlin Mobile Brain / Body Imaging Lab

1.

Background

Psychological and computational problems



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Unt. Fauler Pelz
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Ingrim str.
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Brückentor
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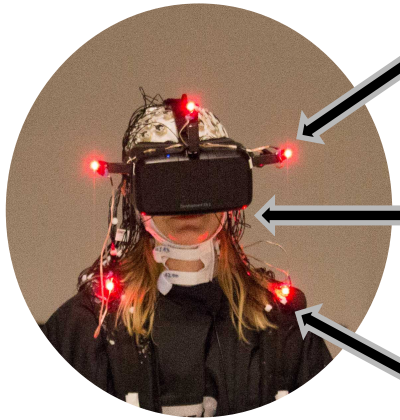
HOTEL
RESTAURANT

MOBI Experimental Setup



VR Headset w/
motion sensors

Microphone and
headphones

Motion capture
rigid bodies

160 channel
EEG mount

Gaming laptop for
visual stimuli

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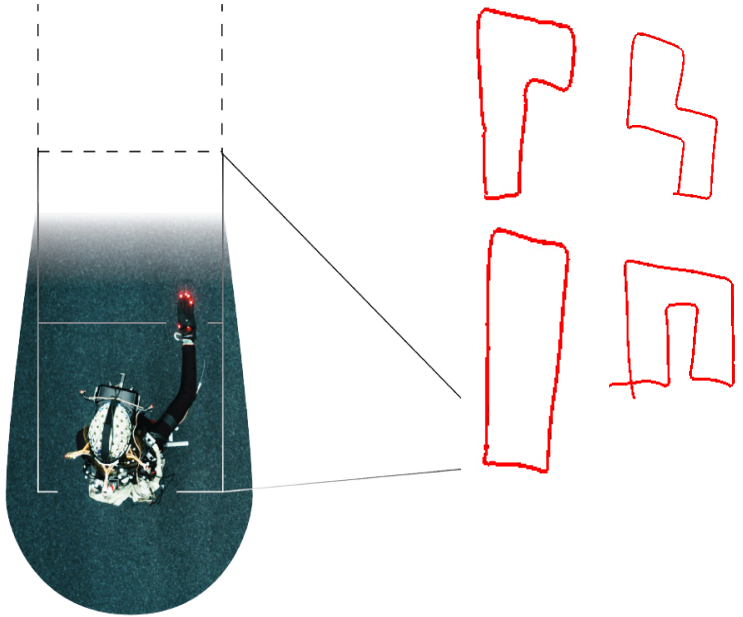
The Virtual Maze Experiment

- Participants navigate through a virtual maze, touch walls to see them appear
- 4 maze types, 3 trials in each maze
- Brain activity is examined during the wall touches
- Draw sketch maps of the maze after each trial



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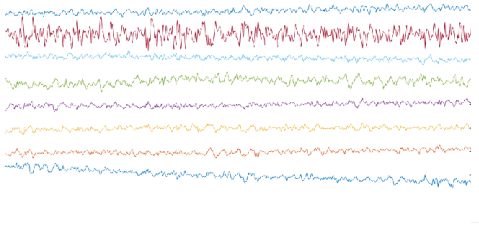
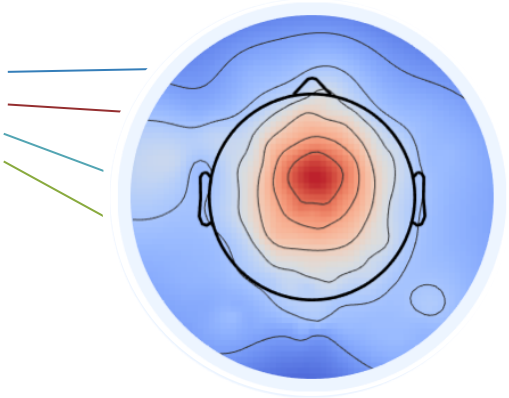
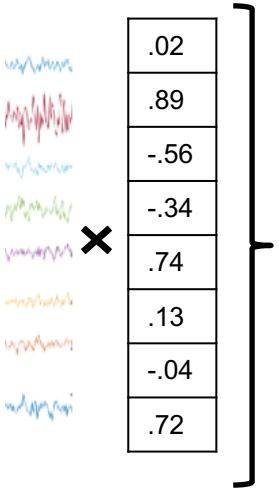
Spatial Filters and Blind Source Seperatoin



EEG time series



EEG channel positions (head from above)

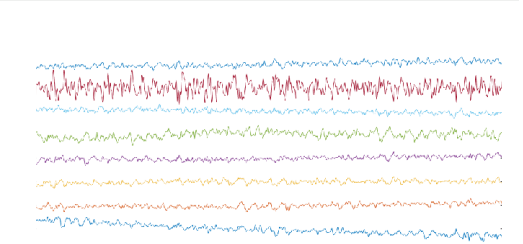


Spatial filter

Meaningful component in data

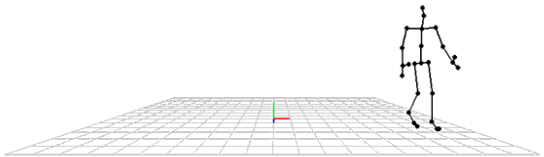
- Eye movement
- Cortex activation

Adding Motion Capture

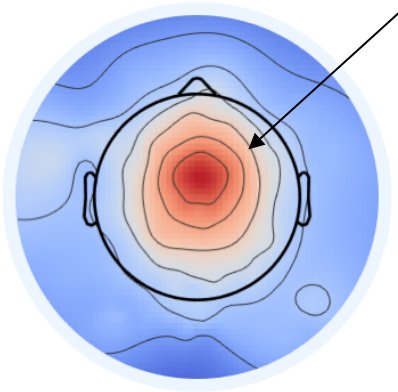


160 channel EEG

+



Motion capture



Activity correlated with the body's movement through space

2.

Methods & Results

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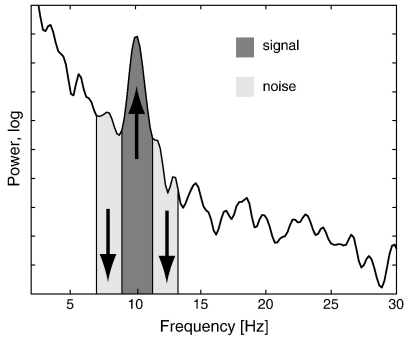
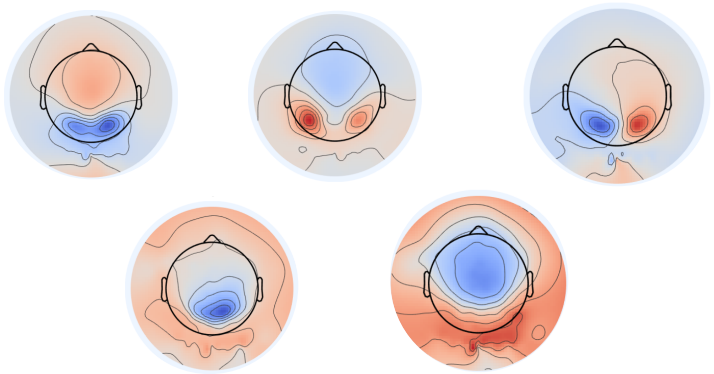
Spatio-spectral decomposition (SSD)

Main idea: Maximize the signal power at a peak frequency while simultaneously minimizing it at the neighboring, surrounding frequency bins



[Nikulin, Nolte, & Gurio; 2011]

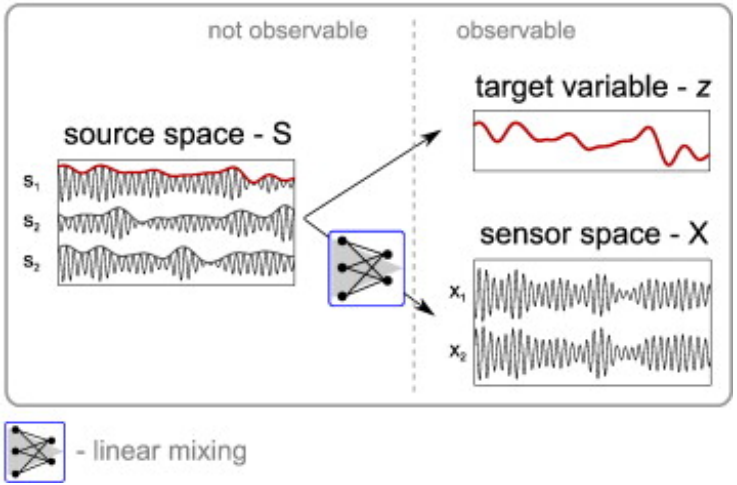


SSD components in alpha frequency range

Source power co-modulation (sPOC)

Main idea: Make unsupervised blind source separation more accurate by introducing a target variable (supervised learning)

Use target variable in decomposition to prefer components whose power co-modulates with target

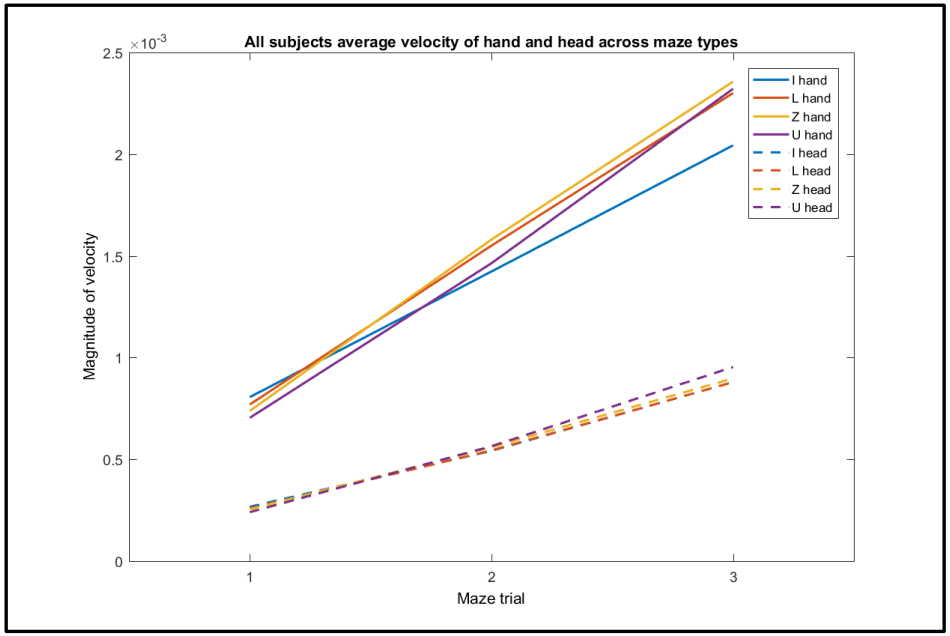


[Dahne et. al; 2013]

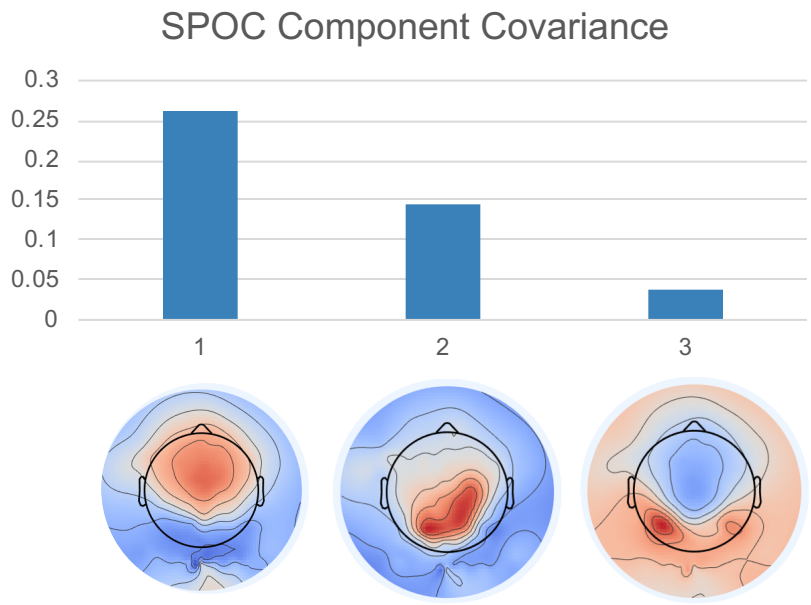
Selecting a target variable

How to encode 3D position, velocity, and acceleration in a psychologically meaningful way?

- Continuous variable encoding spatial learning



SPOC Preliminary Results



Thanks!

Any questions?

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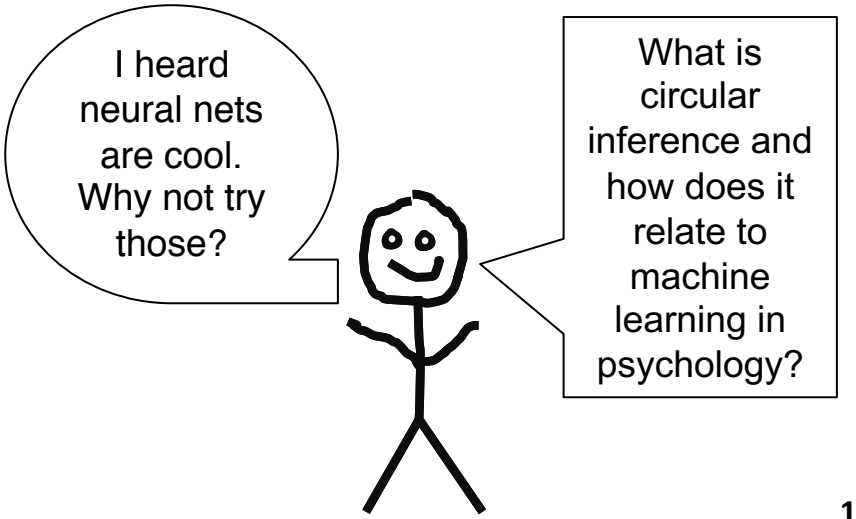

Image credits

[1] https://pixabay.com/en/heidelberg-bridge-neckar-old-bridge-2726938/

[2] http://soileiragusgonta.com/map-heidelberg-germany/map-heidelberg-germany-15-ich-liebe-maps-pinterest/

[3] https://www.amberusa.com/equipment/mri/1-5t/ge-brivo-mr355

[4]https://openi.nlm.nih.gov/detailedresult.php?img=PMC3956891_pone.0092026.g002&req=4

[5]