int_deepmreye

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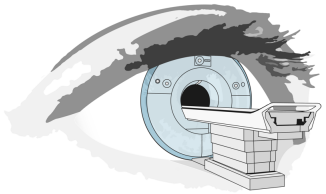
Project : int_deepmreye
With : Matthias NAU, Martin SZINTE
Version: 0.1



DeepMReye

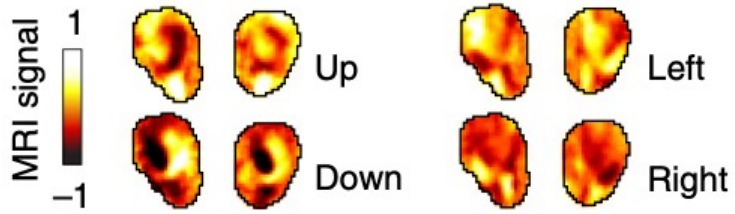
Magnetic resonance-based eye tracking
using deep neural networks

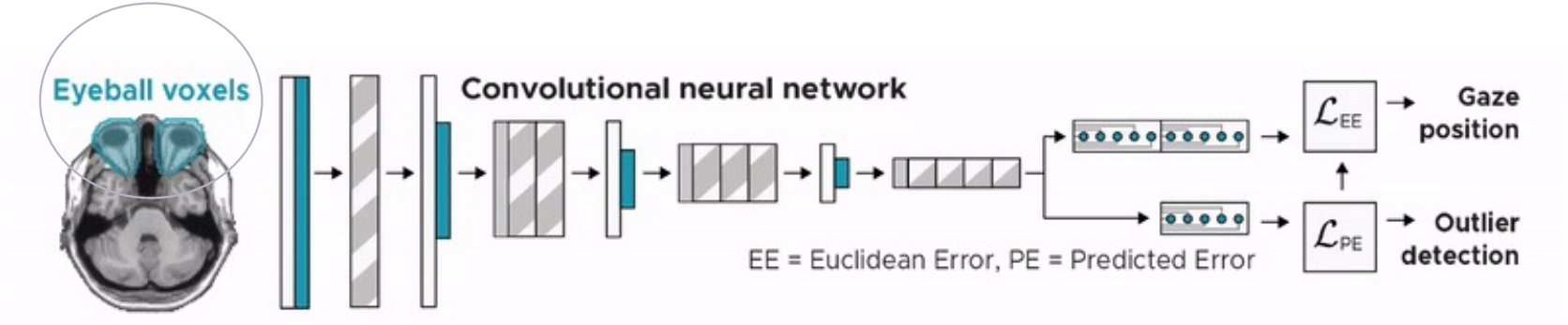
nature neuroscience

Magnetic resonance-based eye tracking using deep neural networks

Markus Frey ✉, Matthias Nau ✉ & Christian F. Doeller

DeepMReye

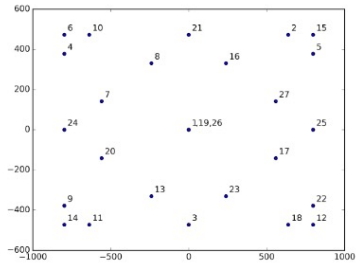

MRI signal
1
−1
Up
Down
Left
Right

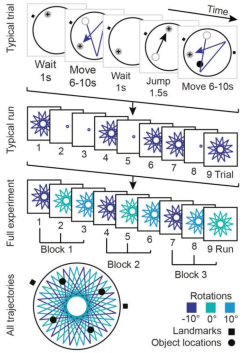

Eyeball voxels
Convolutional neural network
EE = Euclidean Error, PE = Predicted Error
$\mathcal{L}_{EE}$
$\mathcal{L}_{PE}$
Gaze position
Outlier detection

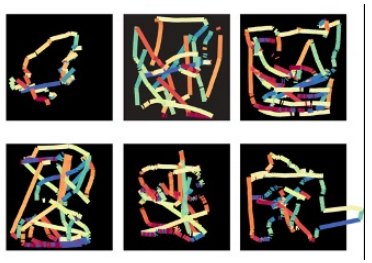
[1]

Training process

Trained initially on 3T data from 268 participants. Includes guided fixation, pursuit and visual search tasks







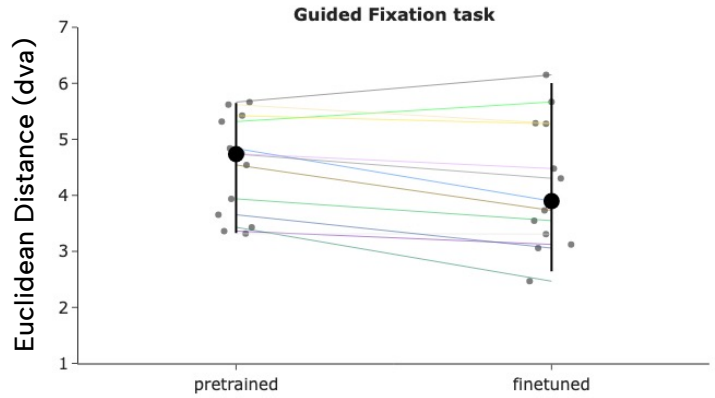
Fine-Tuning Data & Task-Specific Adaptation

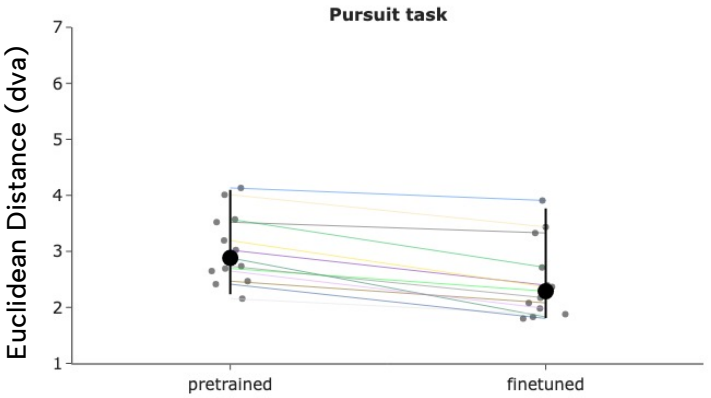
Dataset: Dataset of 15 subjects collected at CERIMED (MB4, 2mm isotropic, 1.2 sec TR, whole head 60 slices, AP)

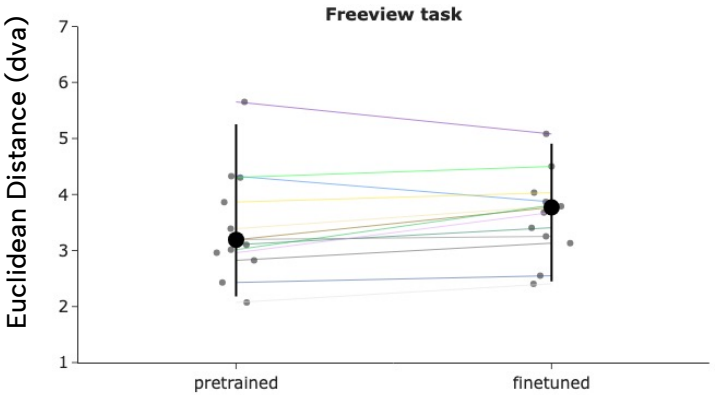
Preprocessing mri data: fmri prep standard pipeline

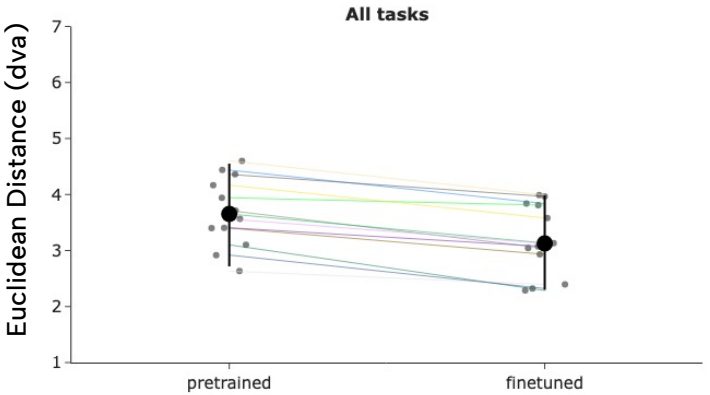
Labels: Gaze positions were recorded with an Eyelink 1000 eye-tracker. Only TRs with more than 50% still remaining data after blink removal were downsampled (median of 10 bins) to subTR resolution (10 per TR)

Performance

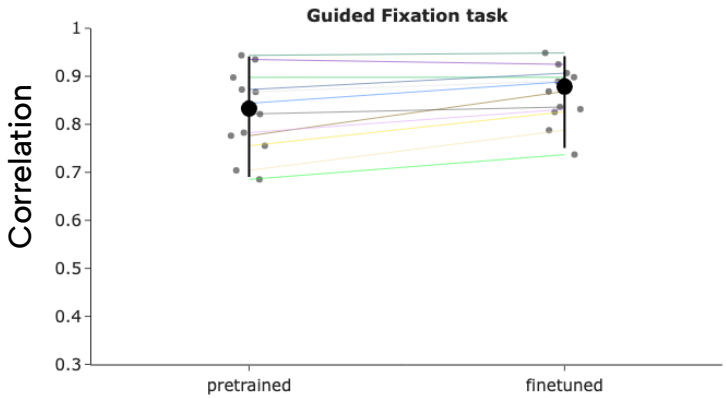


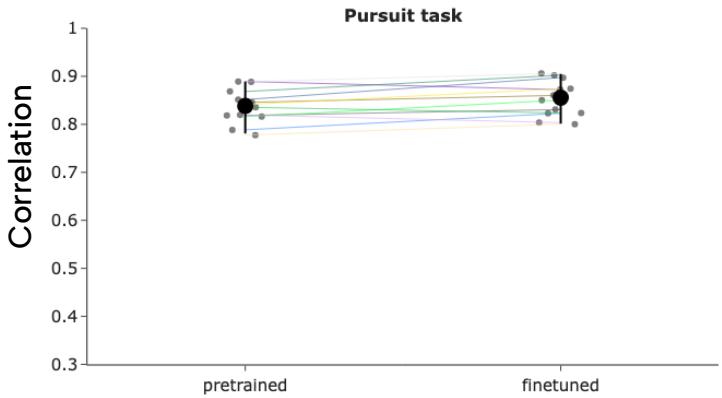


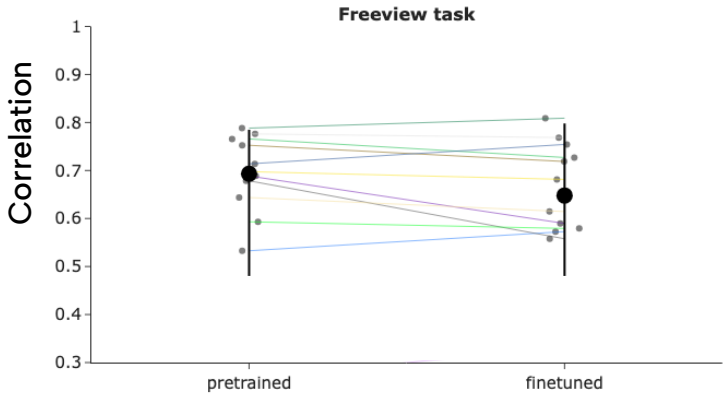


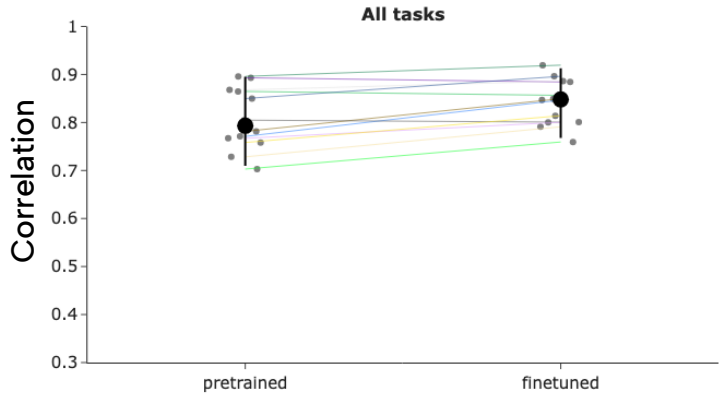


Performance

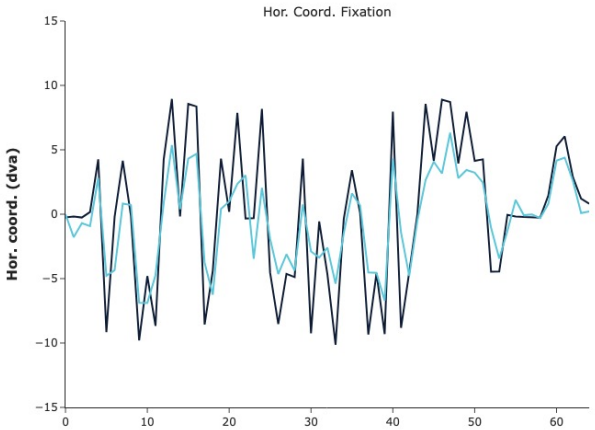


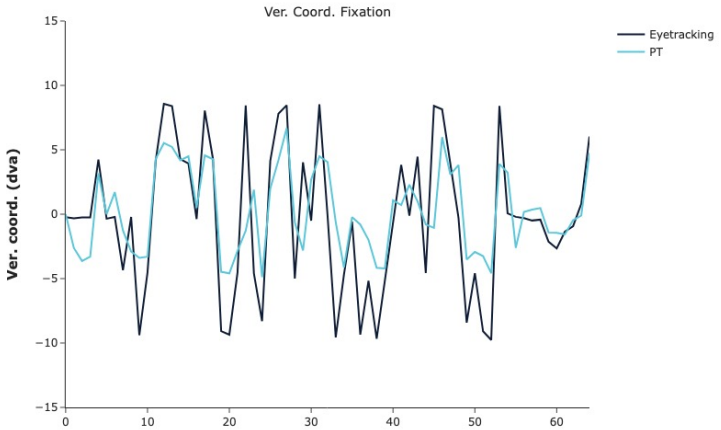




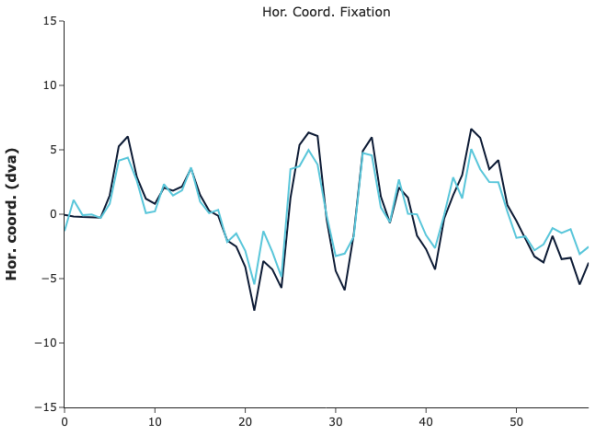


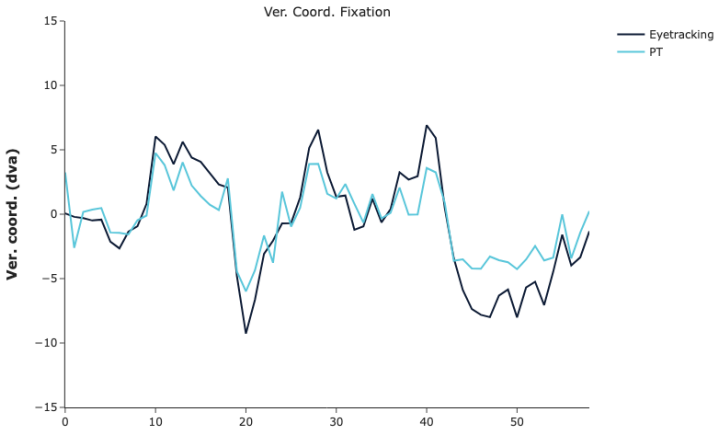
Results





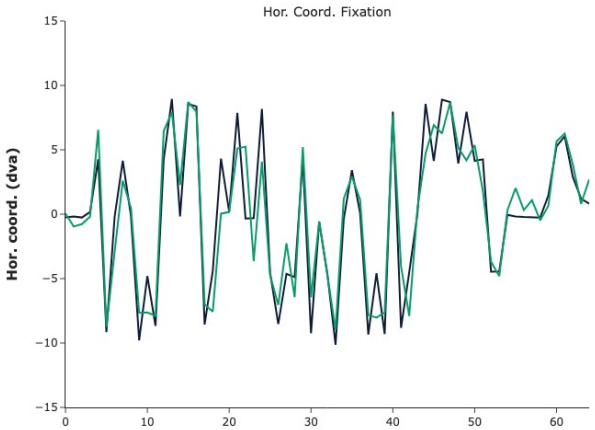
Guided Fixation

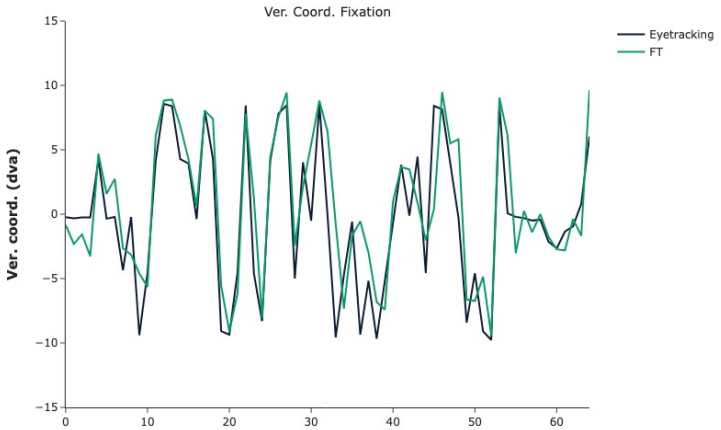




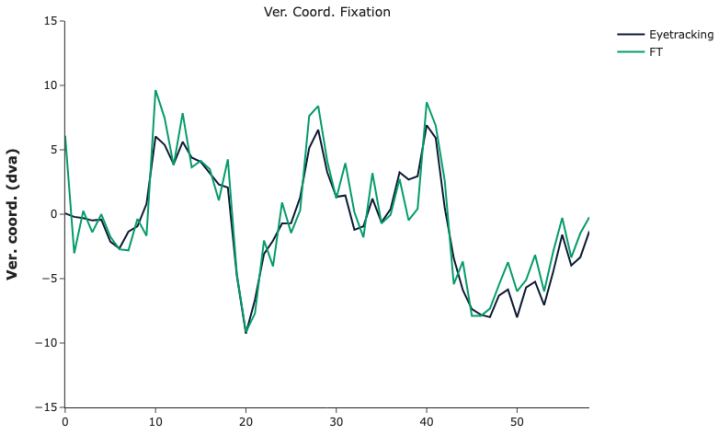
Pursuit

Results





Guided Fixation



Pursuit

Implementation Guide

https://github.com/sinaklg/int_deepmreye/blob/main/int_deepmreye.py

What is needed for decoding gaze with int_deepmreye?

1. BOLD timeseries (4D nii.gz) preprocessed and registered to individual T1w structural scans using fmriprep. Need to be head motion corrected. Need to have eyeballs fully scanned.

2. Downloaded weights (int_deepmreye_weights.h5)

Troubleshooting & Limitations

Troubleshooting

- Check registrations to eye voxel masks (reports)

Model limitations

- Best performance for guided fixation and pursuit tasks.
  For steady fixation and freeviewing consider additional fine-tuning

- Output resolution is maximum 10*TR. To get highest accuracy it is recommended to use 1*TR predictions