Attractor Dynamics in Neural Activity During Motor Task Learning

| Final Project Report | Ian Jackson | ECE590: Brain-Computer Interfaces |

Troubleshooting

- Why only -90 to 90 degrees showing?
- Check the movement data (show a plot of movement video)
- Try averaging instead of summing spike counts to account for noise (maybe even normalize to reduce noise)

Characterizing the Spiking Data

Plotting spikes

- Figure: show the spiking

Gaussian windowing

- Figure: compare the raw spiking activity with and without a Gaussian window

Channel-based and unit-based spiking

- Figure: compare spiking from units vs. channels

Directional Tuning

- Figure: angular preferences for each unit
- Figure: angular preferences for each channel

Attractor Dynamics

What is an attractor?

- Examples: Hopfield Network, strange attractor (Lorenz system)

Why attractors for neural networks?

- Examples: Lukashin et al. (1996), Stringer et al. (2003), Khona & Fiete (2022)

Modeling Spiking Data as an Attractor Network

- Method: use just the time varying spike rate (Khona & Fiete), will have to look at individual cases of movement angle
- Figure: plot movement angle by firing rate
- Figure: plot movement angle by firing rate standard deviation
- Stationary, periodic, or chaotic?

What's Next / What I Missed

- Noise modeling to increase SNR
- Channel summing/averaging for spike counts

- Could be that their unit detection algorithm is just wrong
- Maybe I should look at the waveform rather than the spikes