

Supplementary Material for the manuscript “Predicting proprioceptive cortical anatomy and neural coding with topographic autoencoders” by Kyle P. Blum^{1*}, Max Grogan^{2*}, Yufei Wu^{2*}, J. Alex Harston², Lee E. Miller¹ & A. Aldo Faisal^{2,3}

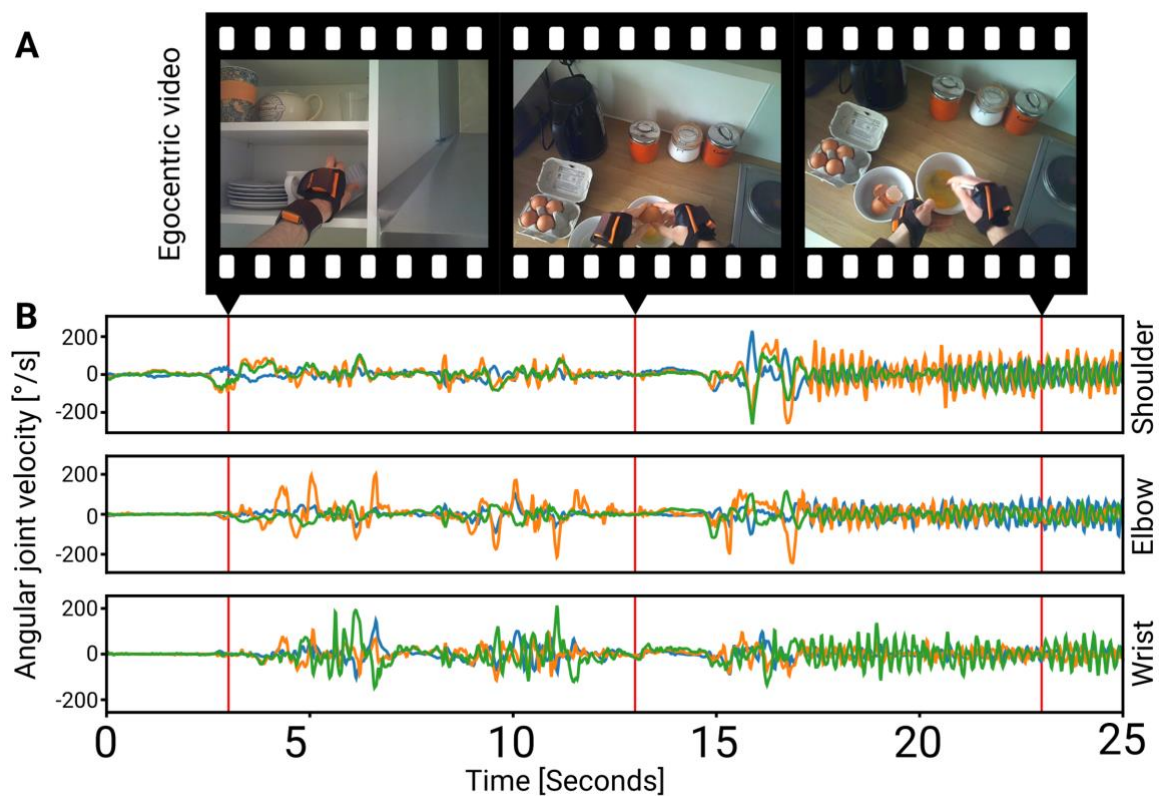
* contributed equally to the work

¹ Northwestern University

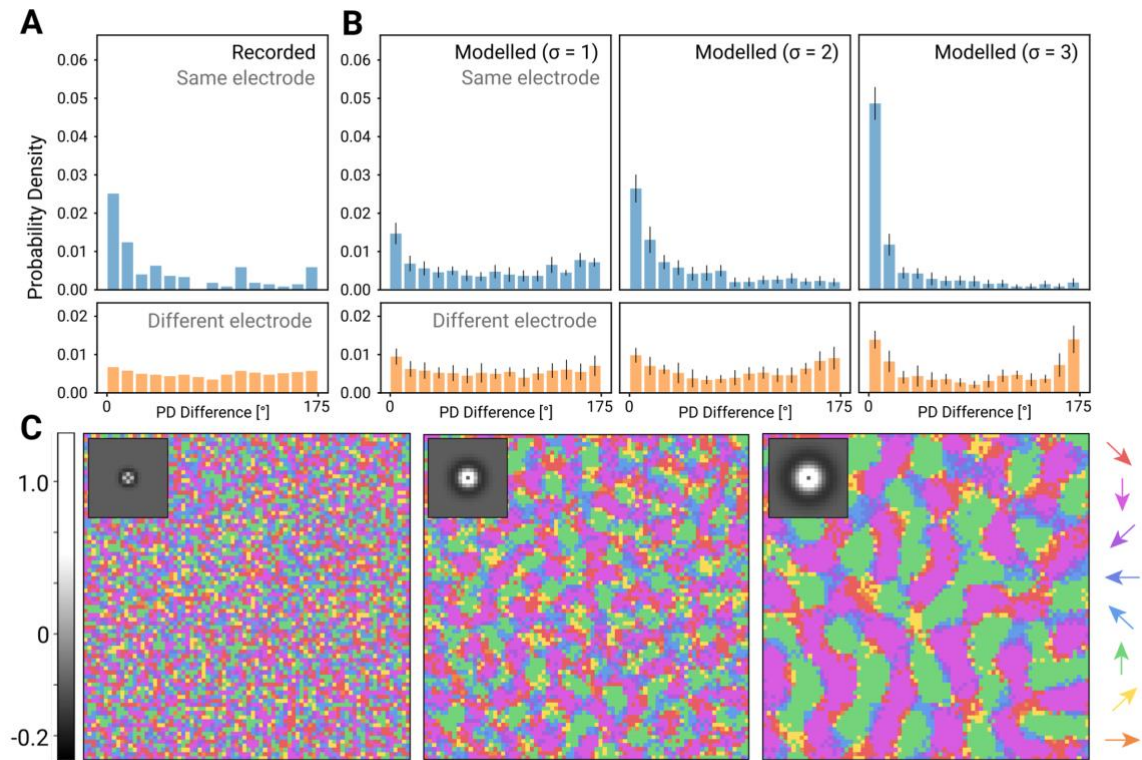
² Imperial College London

³ University of Bayreuth

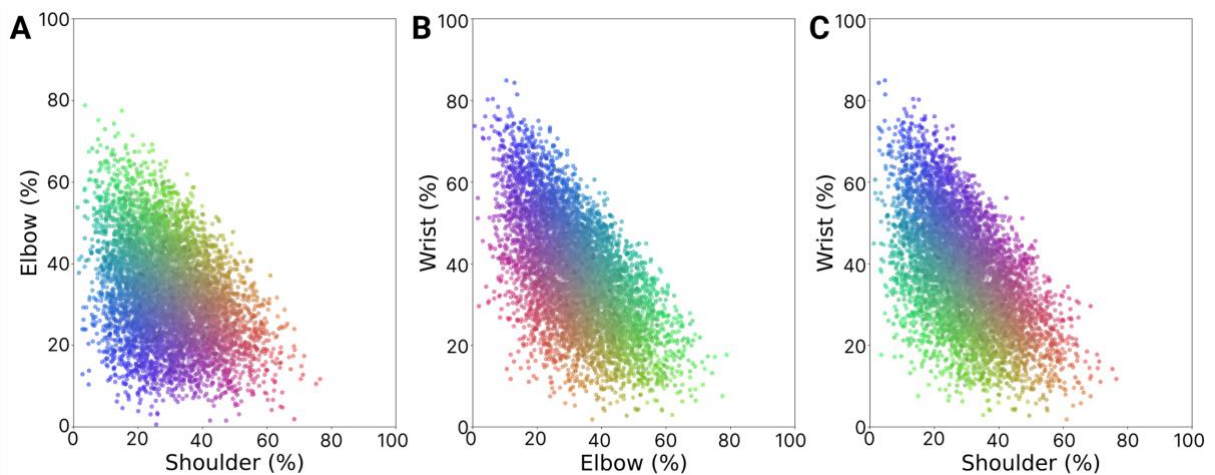
Supplementary Figures



Supplemental Figure 1. Natural kinematics from behaviour in daily life. (A) Examples of natural behaviours contained in the dataset, as seen through egocentric video. (B) 9-dimensional angular joint velocity time series of XYZ joint axes (blue/green/orange lines, respectively) for shoulder, elbow, and wrist joint. Red lines correspond to the natural behaviours shown in (A).



Supplemental Figure 2. Effect of σ on cortical topography. (A) Distribution of PD difference for same electrode and different electrode comparisons in recorded neurons and (B) modelled neurons, with $\sigma=1, 2$, and 3 shown on the left, middle, and right, respectively ($n=6400$). Standard deviation across 10 models with different weight initialisations is indicated by a black bar for each bin. (C) PD maps for $\sigma=1, 2$, and 3 shown on the left, middle, and right, respectively. A visualisation of the lateral effect under σ is also shown inset for each map.



Supplemental Figure 3. Neural representation of joints along the arm (wrist, elbow, shoulder) by plotting the sensitivity of a neuron's sensitivity with each joint's movement. Sensitivity is defined as the cumulative correlation (sum of correlations across X/Z/Y joint angle axes) of a neuron with inputs from the shoulder, wrist, and elbow. A neuron's sensitivity is normalised to 100%, so that e.g. a neuron with equal elbow, shoulder and wrist representation would have 1/3 weight respectively. The 2D plots are showing the relative sensitivity of each neuron to joint inputs for the following pairs: (A) Elbow vs Shoulder, (B) Wrist vs Elbow, and (C) Wrist vs Shoulder. The colour of each dot is set by using their x, y, and

z location in the plot to drive their respective Red, Green B Blue colour channels. The 3D plot of neurons for wrist, elbow and shoulder together are shown in Fig. 6 in the main text.

Supplementary Code & Data

The supplementary code and data which generated all main figures presented in this manuscript are found in a Figshare repository here:

<https://figshare.com/s/e028d90e33041bd5c3b3>

The Figshare will be made publicly accessible upon publication.