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Supplemental information

Propagating motor cortical patterns of excitability are ubiquitous across human and non-human primate movement initiation

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Supplementary Material

Data S1: [Related to Figure 2] Narrow vs wide beta band

Beta frequency signals are generally quite noisy on a single-trial basis, and extracting spatiotemporal patterns are not trivial. For this reason, most previous studies relied on trial-averaged beta signals. In our previous work, we used auto-encoders to de-noise the signal and were able to extract patterns from single trials. Having a wider bandwidth makes the signal prone to noise, and is a primary reason to use a narrow band around the peak beta power.

However, we did examine widening the beta band from 27-33 Hz to 18-36 Hz and computed the propagation speeds for the human data. The propagation speeds became slightly slower for the wider beta band. Furthermore, the number of trials with planar fit R^2 values meeting the selection criterion dropped from 200 to 168 trials. Figure S1 shows the propagation speed distributions for the two bandwidths.

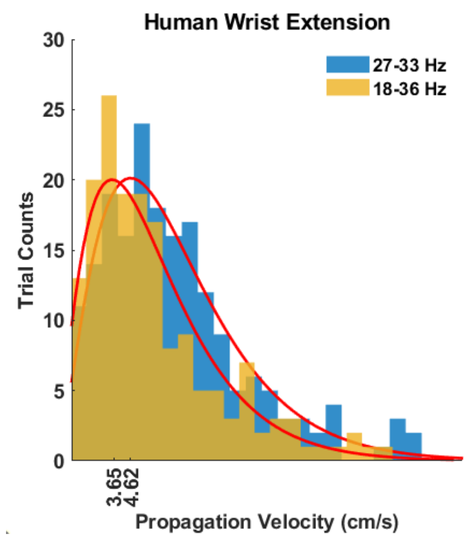

Figure S1: [Related to Figure 2] Distributions of BAO propagation speed in the human wrist extension task computed with two different beta bandwidths. The narrow band (27-33 Hz) had higher mean propagation speed (4.62 cm/s) compared to the wider band (18-36 Hz; mean speed of 3.65 cm/s).

Data S2: [Related to Figure 3] Shuffling Analysis

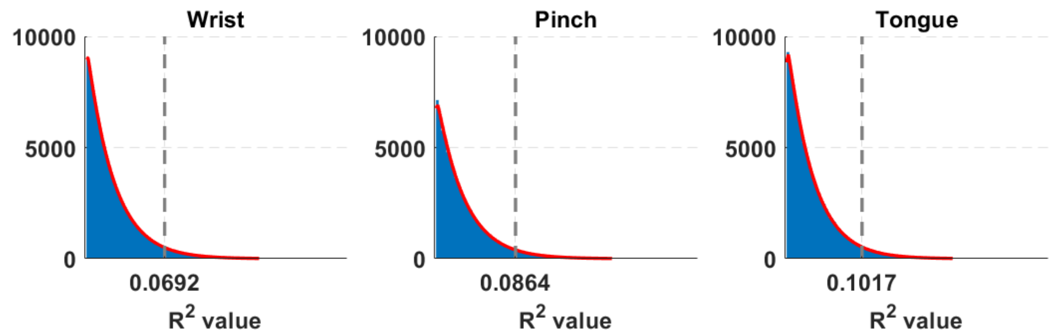

Figure S2: [Related to Figure 3] Distributions of R^2 of BAOs estimated with electrode positions shuffled. The dashed line indicates 5% of the area under the curve, and was used as the R^2 threshold for including the trials for analyses.

Data S3: [Related to Figure 3a] von-Mises fit of BAO distribution

To determine the optimum number of modes for the von-Mises fit to the BAO distribution, we computed the Akaike Information Criterion (AIC) for a range of modes from 1 – 10. The minimum AIC turned out to be 8 modes. However, the incremental improvement in AIC was largest when the number of modes was increased from 1 to 2, with marginal improvements when the number of modes were incremented beyond 2. Figure S4 shows the AIC plot for the various modes from the Tongue Protrusion task. Similar trends were found for the remaining behaviors.

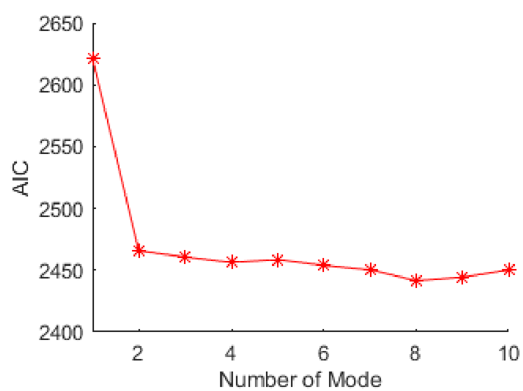

Figure S3: [Related to Figure 3a] AIC plot for choosing optimal number of modes to fit the BAO distribution for Monkey Yk performing the tongue protrusion task. Fitting with two modes provided the largest incremental improvement.

Data S4: [Related to Figure 5] Response time distribution

The response time distribution for the three tasks (planar reach, tongue protrusion and human wrist extension) is shown in Figure S4.

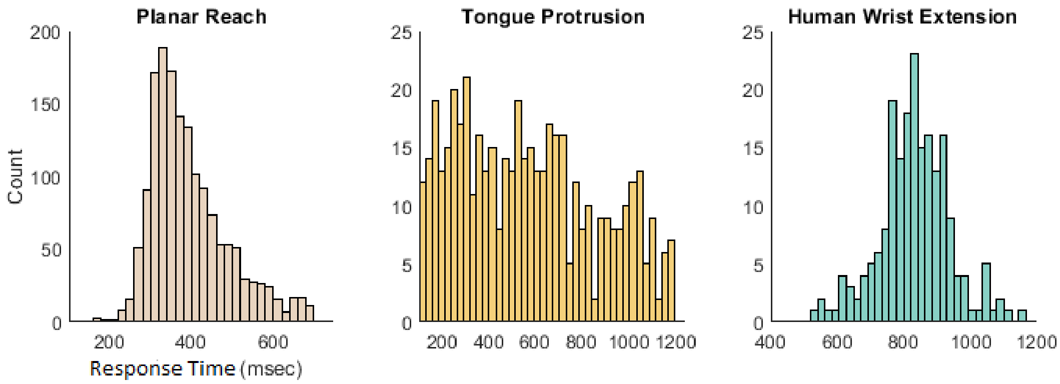

Figure S4: [Related to Figure 5] Distribution of response times across three of the tasks.

Data S5: [Related to Figure 5] Power spectrum of trials grouped by the BAO propagation direction

The power spectral densities of the trials grouped by the propagation directions in Monkey Bx using data across 6 sessions show that the trials propagating in caudo-lateral direction have relatively lower signal power compared to the rostro-medial trials (see Figure S5). However, the frequency at peak power did not vary.

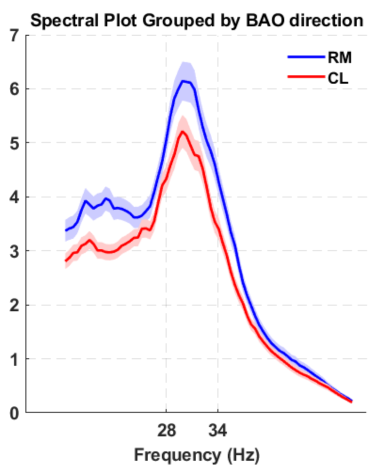

Figure S5: [Related to Figure 5] Comparison of beta power in Monkey Bx for trials grouped by the BAO propagation direction. Trials propagating towards the sulcus (i.e., caudo-lateral) showed relatively weaker peak beta power than the trials propagating away from the sulcus (i.e., rostro-medial).

Data S6: [Related to Figure 5] Relation between response time and movement time

We did not find any notable relation between the response time (RT) and the movement time. Figure S6 shows the relationship plot for two of the tasks. Their corresponding Pearson's Coefficient are 0.068 and 0.047. For the human wrist extension task, we looked at the relation between the RT and the time to peak force, and found a weak correlation of 0.059.

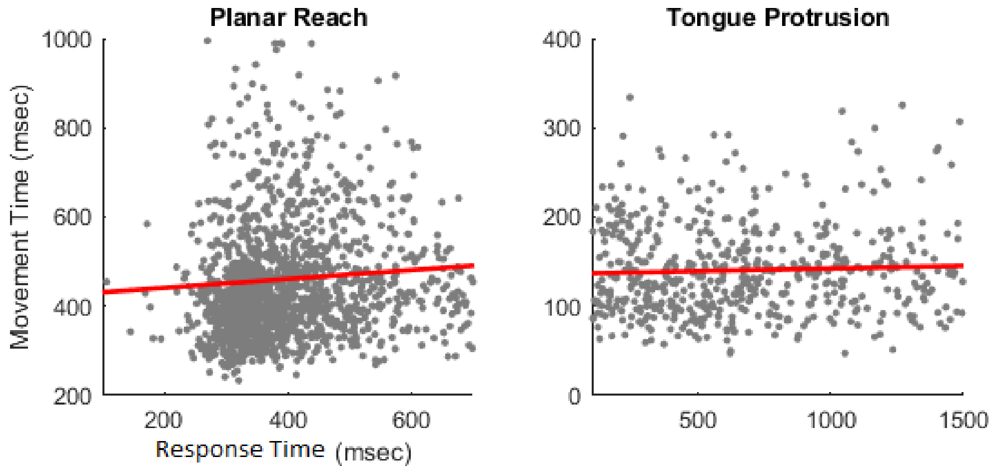

Figure S6: [Related to Figure 5] Plot showing relation between response time and movement time. The correlation coefficients for the planar reach task and tongue protrusion task are 0.068, and 0.047, respectively.

Data S7: [Related to Figure 5] Relation between response time and propagation speed

To determine if the response time has any relation with the propagation speed, we looked at the propagation speed as a function of the former, and did not find any discernible pattern (see Figure S7 for illustration from Monkey Bx).

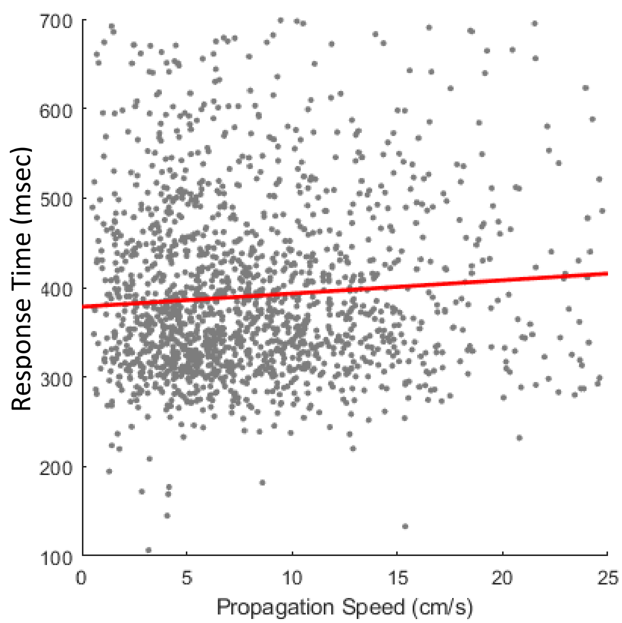

Figure S7: [Related to Figure 5] Propagation speed as a function of response time for Monkey Bx making planar reaches. The correlation was very weak (Pearson's coefficient: 0.067).