A More Details of the LFP Experiment

In this section, we give some detail on the Sync-RKM model. In order to incorporate SyncNet model [21] into our framework, the weight $W^{(x)} = \left[W^{(x_0)}, W^{(x_{-1})}, \cdots, W^{(x_{-n+1})}\right]$ defined in Eq. (12) is parameterized as wavelet filters. If there is a total of K filters, then $\boldsymbol{W}^{(x)}$ is of size $K \times C \times n$.

Specifically, suppose the n-gram input data at time t is given as $\boldsymbol{X}_t = [\boldsymbol{x}_{t-n+1}, \cdots, \boldsymbol{x}_t] \in \mathbb{R}^{C \times n}$ with channel number C and window size n. The k-th filter for channel c can be written as

$$\boldsymbol{W}_{kc}^{(x)} = \alpha_{kc} \cos\left(\omega_k \boldsymbol{t} + \phi_{kc}\right) \exp(-\beta_k \boldsymbol{t}^2) \tag{21}$$

$\boldsymbol{W}_{kc}^{(x)}$ has the form of the Morlet wavelet base function. Parameters to be learned are α_{kc}, ω_k, ϕ_{kc} and β_k for $c = 1, \cdots C$ and $k = 1, \cdots, K$. $\boldsymbol{t}$ is time grid of length n, which is a constant vector. In the recurrent cell, each $\boldsymbol{W}_{kc}^{(x)}$ is convolved with the c-th channel of $\boldsymbol{X}_t$ using 1-d convolution. Figure 1 gives the framework of this Sync-RKM model. For more details of how the filter works, please refer to the original work [21].

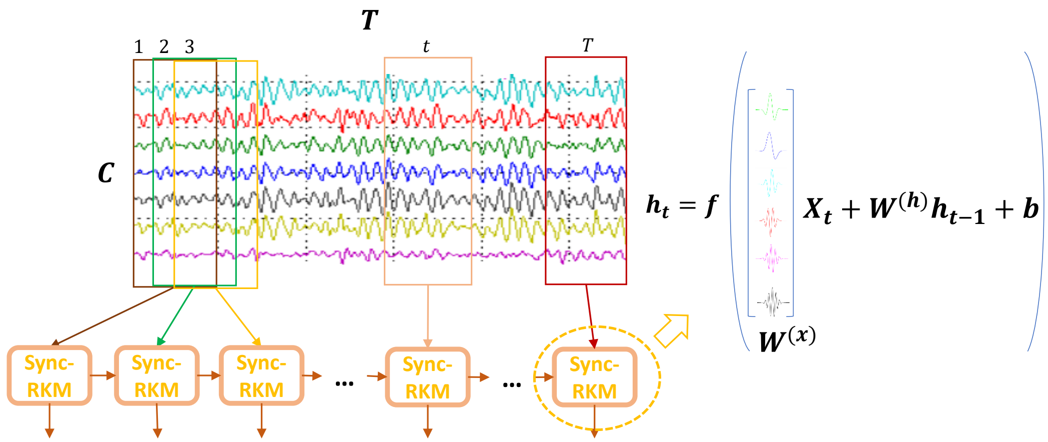

Figure 1: Illustration of the proposed model with SyncNet filters. The input LFP signal is given by the $C \times T$ matrix. The SyncNet filters (right) are applied on signal chunks at each time step.

When applying the Sync-RKM model on LFP data, we choose the window size as $n = 40$ to consider the time dependencies in the signal. Since the experiment is performed by treating each mouse as test iteratively, we show the subject-wise classification accuracy in Figure 2. The proposed model does consistently better across nearly all subjects.

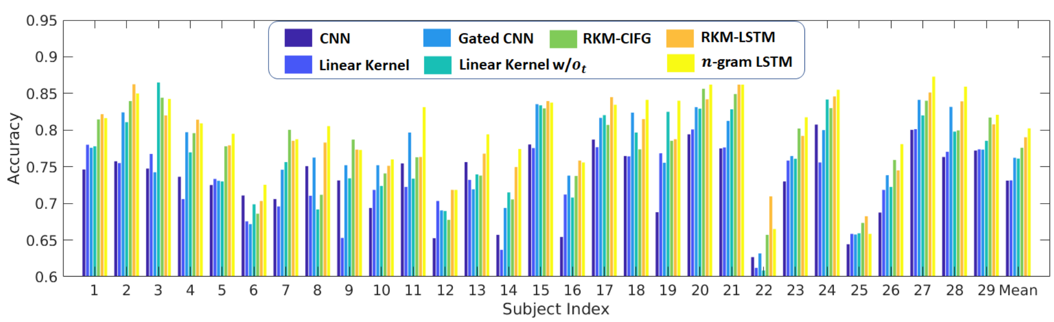

Figure 2: Subject-wise classification accuracy comparison for LFP dataset.