Extracting functional components of neural dynamics with Independent Component Analysis and inverse Current Source Density

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Choice of k for experimental data

To choose k, the number of independent components sought, for the experimental data we performed the ICA analysis for $3 \leq k \leq 32$ (one run for each k). For each animal we pooled all the 525 components obtained and applied the clustering procedure described in Section 2.3. We divided the data into $M = 32$ clusters and plotted the clusters against k, Fig. 1. Each dot represents one component. For each k we count the number of clusters, $h(k) \leq M$, containing at least one component obtained through ICA for this k. We calculate $h(k)$ for each animal separately and take the mean $H(k)$ and standard deviation, Fig. 2. For our experimental data we have initially $H(k) \simeq k$, then for $k > 15$ the line $H(k)$ has slightly smaller slope, and finally, for $k \sim 25$, $H(k)$ deviates strongly from the diagonal. At the same time, one of the clusters (for Rat No 1 it is cluster 16 in Fig. 1) starts to absorb the additional components. This cluster comprises mainly very weak components (not shown). We conclude that starting from this point the additional components are noise, or too small to be stably separated. Therefore, for analysis of experimental data we take $k = 24$.

Examples of model datasets

Here we show two of the model datasets used for testing of the data analysis methods (Section 3). The dataset presented in Fig. 3 was used in Fig. 1 in the article. Note two types of time courses used: simulated evoked potentials (Fig. 3 A-C) and experimental evoked potentials (Fig. 3 D-H). Fig. 4 presents another dataset, in which we used oscillatory time signals (Fig. 4 A, B) along with simulated evoked potentials (Fig. 4 C-E). Temporal correlation between A) to C) in Fig. 3, and Fig. 4 C-E was intended as a model of (almost) simultaneous activation of several structures and followed the observed properties of the experimental data.

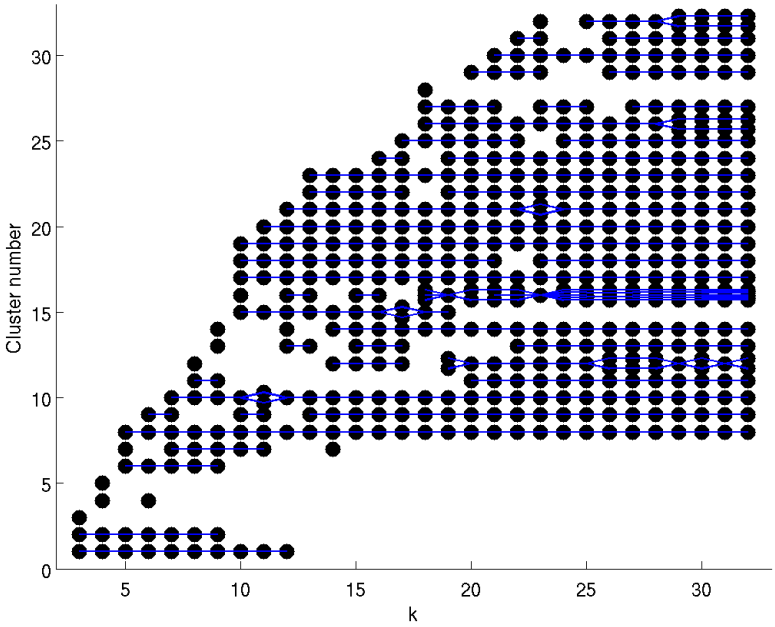

Figure 1: Result of dividing the 525 components obtained through ICA for $3 \leq k \leq 32$ into 32 clusters, data from Rat 1. Each dot represents a single component.

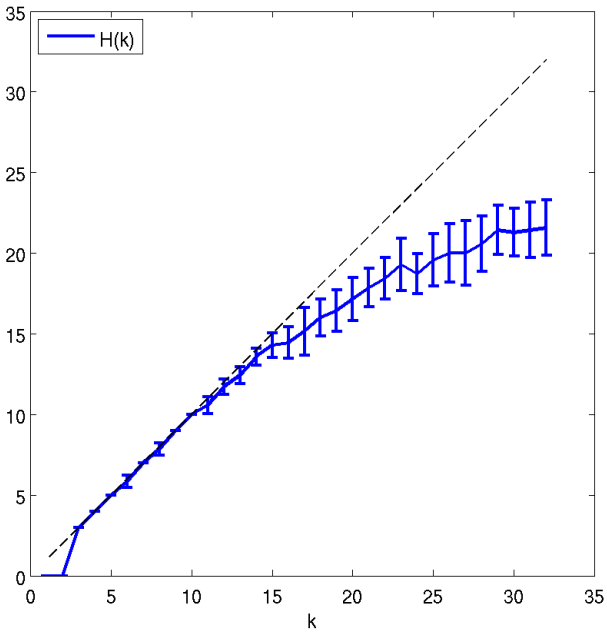

Figure 2: Number of components $H(k)$±standard deviation, see text for details.

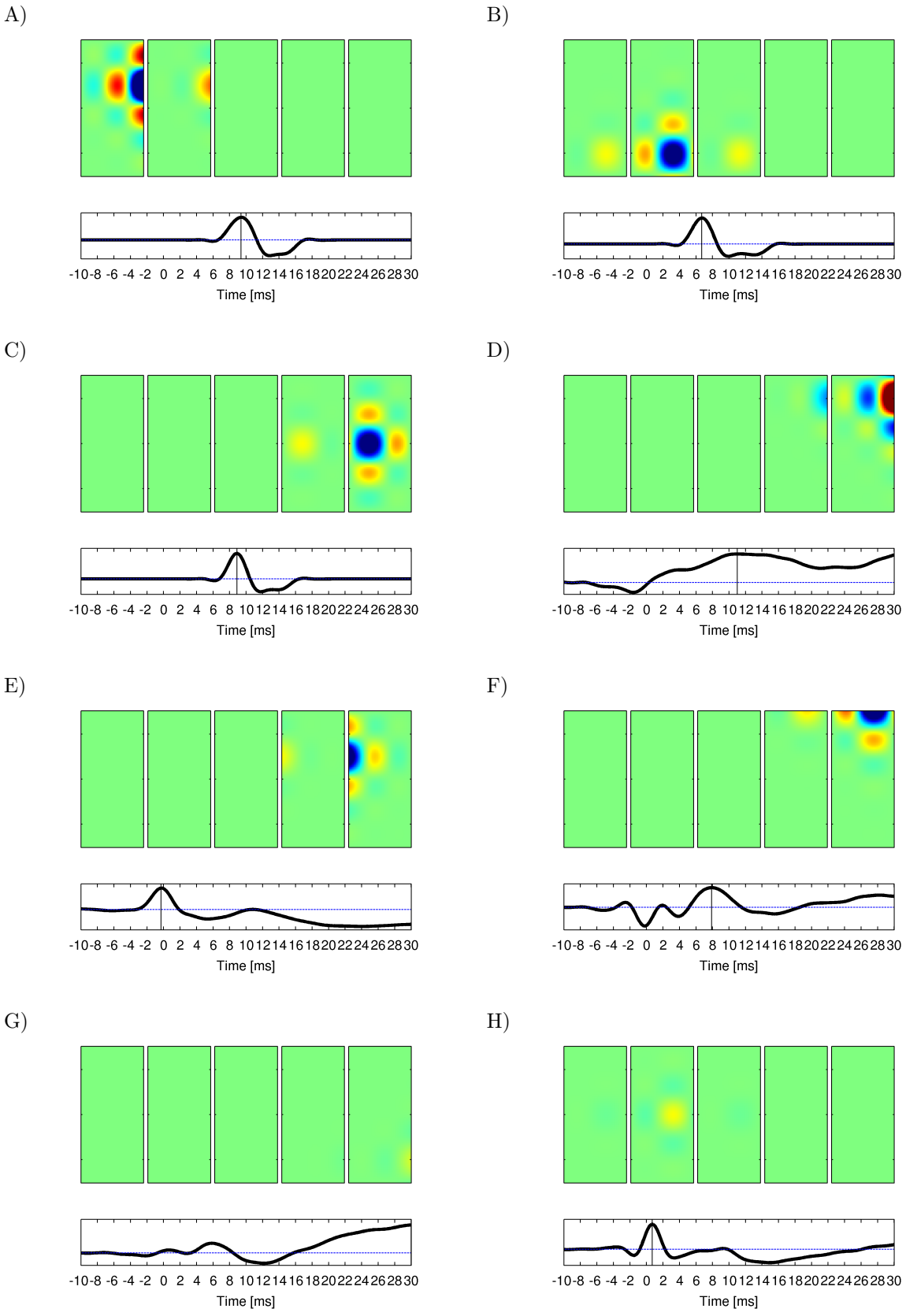

Figure 3: Model dataset No. 1, cf. Fig. 1 in the article. The first three time courses are simulated evoked potentials (type 2 time course in the article), the remaining ones are experimental evoked potentials (type 3 in the article). Note that components G and H have very small amplitude of the spatial function.

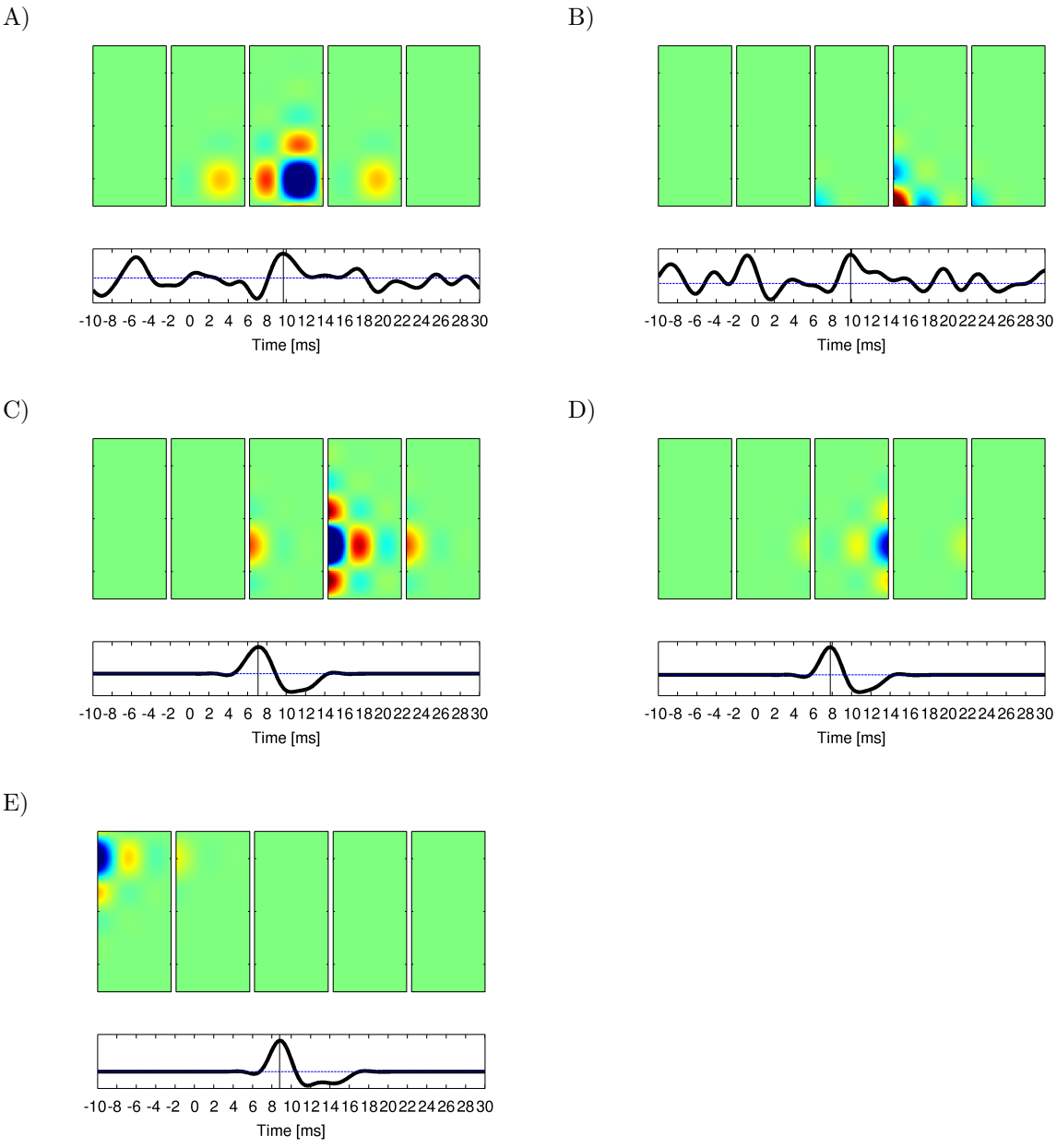

Figure 4: Model dataset No. 2. This figure illustrates the oscillatory time courses (A, B), ie. type 1 time courses in the article.