0.1 Dataset

The dataset consists of twenty-three paired recording with a distance of less than 200 μm between the targeted neuron and the closest extracellular electrode. These were acquired from twenty-three cells, from the cortex of several anesthetized rats.

On figure (figure 1a) is an example of the signal acquired from using the juxtacellular pipette, which, with an amplitude of around 4mV, reveals the typical high signal-to-ratio that the signal this probe yields. On the figure (figure 1b), many of the spikes were aligned and plotted together. We can see that this waveform keeps it shape over the course of the recording. In this case, as is in most of the recording, it has a positive-before-negative biphasic waveform, which is indicative that there was a good coupling between the pipette and the neuron's soma (Herfst et al, 2012). However, in two case, that I used, the waveform has a negative-before-positive profile indicating incomplete contact between the cell membrane and the pipette, lowering the signal-to-ratio (SNR) significantly but remaining detectable. (2015_09_03_Pair9.0 and 2015_09_04_Pair5.0)

With such a high SNR, one can reliably use a simple threshold-based detector to calculate the times (hereafter juxta times) at which the juxta neuron spiked.The earliest extracellular recordings in the dataset were done using the 32-channel probe. Part of one of these recordings after the high-pass filter is illustrated in Fig. 1c. Each of these traces are plotted next to its neighbors, according the geometry of the probe. Most of the spikes are sensed by many electrodes revealing a coherent region of influence. This signal usually doesn't have a high SNR, as can be seen in Fig. 1d. To get the waveform of the EAP on this probe we perform Juxta-Triggered Averages (JTAs), where windows of 4 ms centered on the juxta spikes are averaged so that the noise decreases and the waveform becomes clear. In figure 1g) are represented the JTAs of each electrode in its correct position in the 32-channel probe. It is possible to see that the EAP has a different waveform on different electrode sites. They are also displaced in time: on electrodes farther way, the waveform is delayed with respect to one on a electrode closer to the neuron. The JTA peak-to-peak amplitude for each channel interpolated within the electrode site geometry, sometimes called the cell footprint (Delgado Ruz and Schultz, 2014), is shown in Figure (figure 1f)

During the course of this project I focused on 5 recordings where the 128-channels probe was used. These are presented in figure (figure 6 neto et al.) and summarized in Table 1:

Recording ID	**Distance (μm)**	**P2P (V)**	**Depth (μm)**	**# Juxta spikes**
2015_09_09_Pair7.0	136.2 ± 40	20.7	1032.8	1082
2015_09_04_Pair5.0	96.1 ± 40	30.8	1185.5	185
2015_09_03_Pair6.0	153.3 ± 40	24.1	1063.2	3329
2015_09_03_Pair9.0	11.5 ± 40	416.3	1152.8	5007
2015_08_21_Pair3.0	132.8 ± 40	19.4	1286.0	8117

Table 1: Information about the recordings used

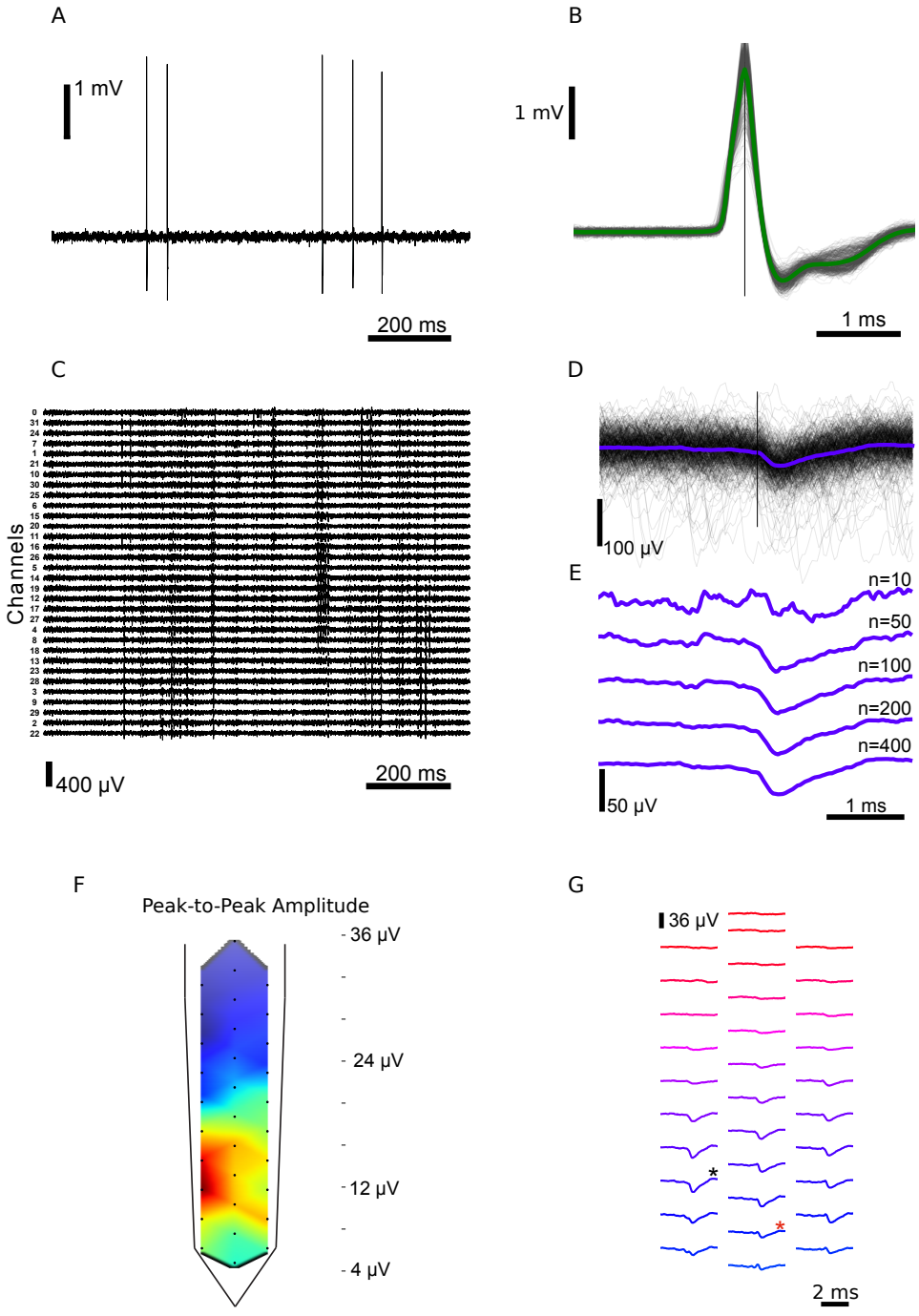

Figure 1: Paired extracellular and juxtacellular recordings from the same neuron (a) Representative juxtacellular recording from a cell in layer 5 of motor cortex, 68 μm from the extracellular probe (2014_10_17_Pair1.0), with a firing rate of 0.9 Hz. (b) The juxtacellular action potentials are overlaid, time-locked to the maximum positive peak, with the average spike waveform superimposed (n= 442 spikes). (c) Representative extracellular recording that corresponds to the same time window as the above juxtacellular recording. Traces are ordered from upper to lower electrodes and channel numbers are indicated. (d) Extracellular waveforms, aligned on the juxtacellular spike peak, for a single channel (channel 18). (e) the juxtacellular triggered average (JTA) obtained by including an increasing number of juxtacellular events (n as indicated). (f) Spatial distribution of the amplitude for each channels extracellular JTA waveform. The