MANUAL CURATION W/ PHY

Sam Kim

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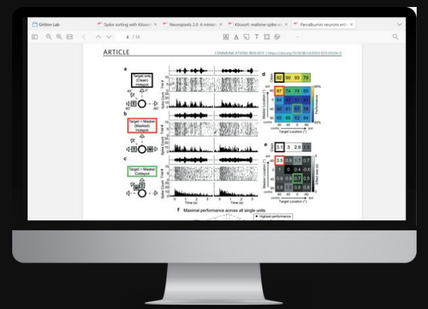
OVERVIEW



TDT & NEURONEXUS

Multi-channel recording

KILOSORT

Automated spike sorting

PHY

Manual curation

RESULTS

Additional metrics

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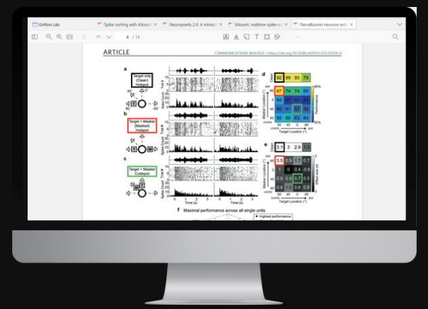
OVERVIEW



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TDT & NEURONEXUS

Multi-channel recording

- Facilitates auditory tasks
  - Exports raw data for processing

KILOSORT

Automated spike sorting

- Detects spikes in raw data
  - Extracts & clusters spike features

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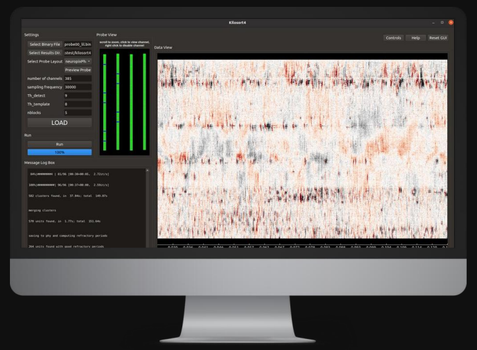
ALGORITHM



KILOSORT

- Preprocessing
- Template deconvolution
- Clustering
- Postprocessing

Read complete algorithm: Kilosort4 Paper

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NON-TECHNICAL

Preprocessing

Clean and prepare data

Template deconvolution

Make temporary guesses to find spikes and improve guesses

Clustering

Stronger guesses

Postprocessing

Bio-informed guess improvement

Read complete algorithm: Kilosort4 Paper

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TECHNICAL

Preprocessing

1. Common average referencing
2. High pass filtering
3. Channel whitening
4. Drift correction

Template deconvolution

1. Detection & feature extraction w/ simple spike templates
2. Graph-based clustering simple features
3. Matching pursuit with learned templates

Clustering

1. Graph-based clustering

Postprocessing

1. Splits or merges

Read complete algorithm: Kilosort4 Paper

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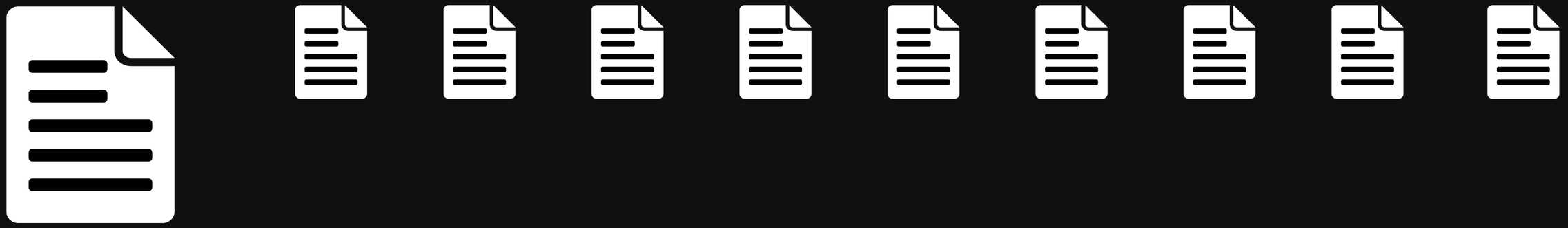

amplitudes.npy

size: (n_spikes, 1)

L2 norm of PC features for each spike

- Proxy for true amplitude
- Useful for comparing spikes of a single cluster

Source Fact

Values in *pc_features.npy* & *template_features.npy* are also used in Phy for AmplitudeView

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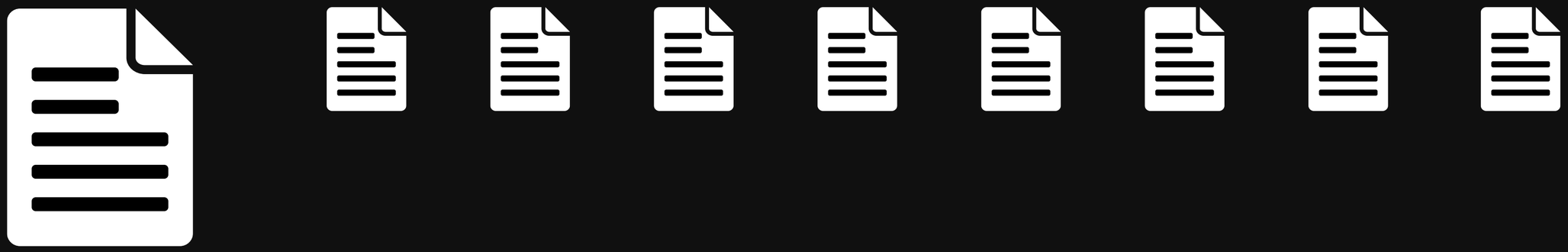
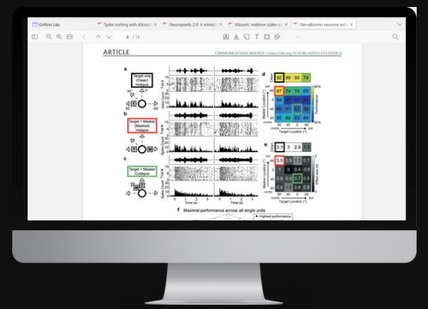


pc_features.npy

size: (n_spikes, n_pcs, nearest_chans)

- Features for each spike across nearest channels
- least squares estimate of amplitude

OVERVIEW



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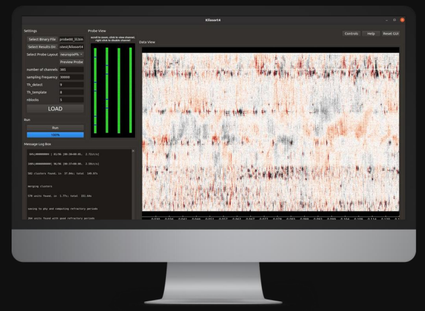

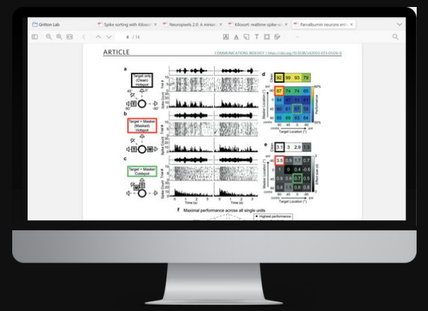

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KILOSORT

Automated spike sorting

- Detects spikes in raw data
  - Extracts & clusters spike features

PHY

Manual curation

- Imports initial clusters
  - Splits or merges clusters

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STEPS

PHY

- [x] Screen
- [x] Merge
- [x] Split
- [x] Label

Watch tutorial: Curating sorted spikes with Phy - Nick Steinmetz (UW)

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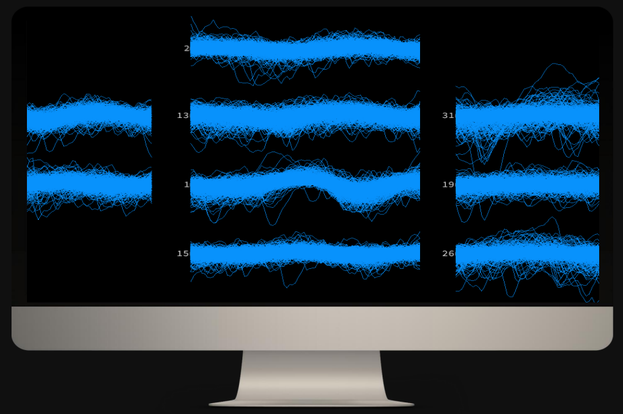
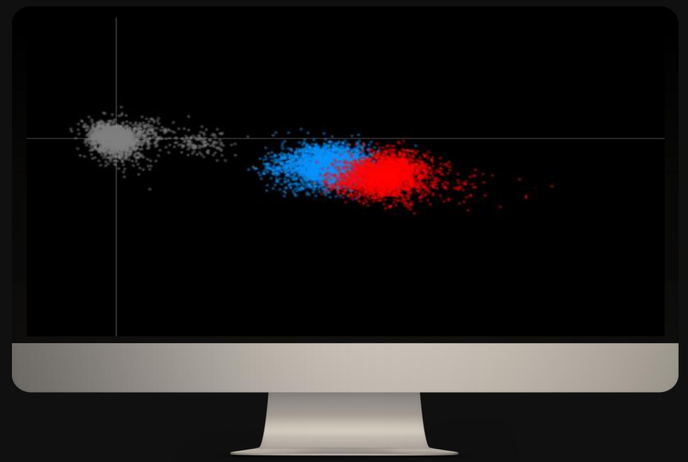
VISUALS

Screen



Merge & Split



Label

6	10	2955	684.10	109.40	1.82
27	10	3863	470.00	57.90	1.39
7	12	16507	1420.50	54.60	0.33
8	14	64503	1855.80	79.30	0.08
9	16	65088	1628.00	23.40	0.08

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TemplateGUI - C:\Users\samue\Downloads\620R 240601

File Edit Select View Help

ClusterView

id ▲	ch	n_spikes	Amplitude	ContamPct	meanisi
6	22	29	623.60	100.00	131.74
8	2	230	1453.00	107285.00	17.19
9	3	53199	1327.30	55.90	0.08
11	23	47	1435.00	inf	87.07
12	6	34207	1266.60	88.70	0.12
13	23	255	466.80	0.00	15.44
14	23	1338	563.70	66.30	2.96
15	9	43431	1289.70	91.00	0.09
16	13	57271	1348.40	99.10	0.07
17	13	887	889.00	1000.00	4.57
18	23	80	734.50	100.00	50.13
19	23	226	574.40	0.00	17.95
20	23	4113	415.80	18.90	0.98
22	13	256	790.90	0.00	15.11
24	19	43565	1173.30	54.40	0.09

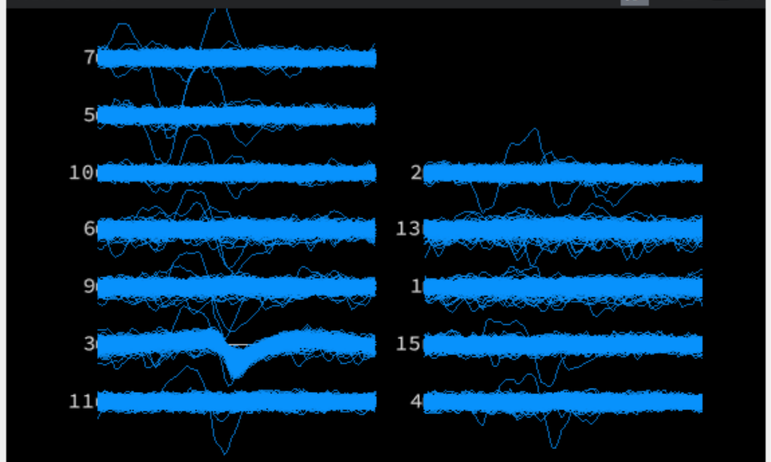
clusters: 9

SimilarityView

filter

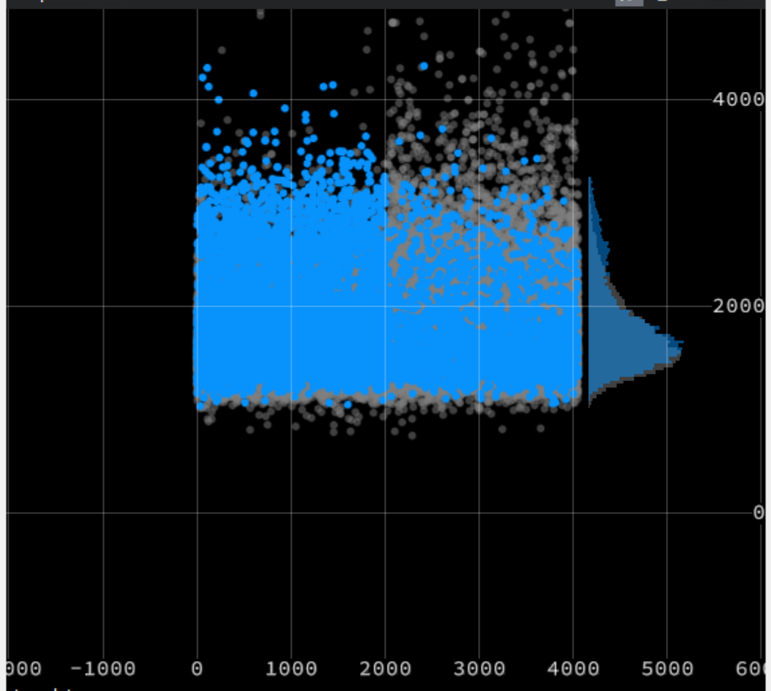
id	ch	n_spikes	Amplitude	ContamPct	meanisi	similarity ▼
66	28	315	405.80	0.00	12.84	0.207
36	28	681	443.20	154.70	5.51	0.168
59	21	59	390.80	100.00	34.01	0.155
34	26	249	899.40	0.00	16.22	0.123
11	23	47	1435.00	inf	87.07	0.103
17	13	887	889.00	1000.00	4.57	0.094
2	1	666	1846.50	1063.60	6.02	0.090
22	13	256	790.90	0.00	15.11	0.078
51	21	977	449.60	260.00	4.13	0.077
6	22	29	623.60	100.00	131.74	0.077
93	4	17023	883.50	30.20	0.24	0.075
50	6	94	774.40	0.00	41.17	0.071
114	2	9980	630.80	105.30	0.41	0.070
14	23	1338	563.70	66.30	2.96	0.065
67	31	79	702.30	390.00	25.04	0.064
15	9	43431	1289.70	91.00	0.09	0.060
45	31	7978	641.00	87.00	0.51	0.059
49	6	2834	710.70	87.50	1.43	0.057
118	1	116584	1332.50	66.50	0.03	0.055
54	23	216	796.30	0.00	18.69	0.050
4	1	2535	780.80	57.40	1.60	0.049
35	23	785	508.40	97.60	5.14	0.049
8	2	230	1453.00	107285.00	17.19	0.048
61	31	350	1059.70	0.00	11.41	0.048
100	29	44384	1031.60	38.90	0.09	0.046

WaveformView



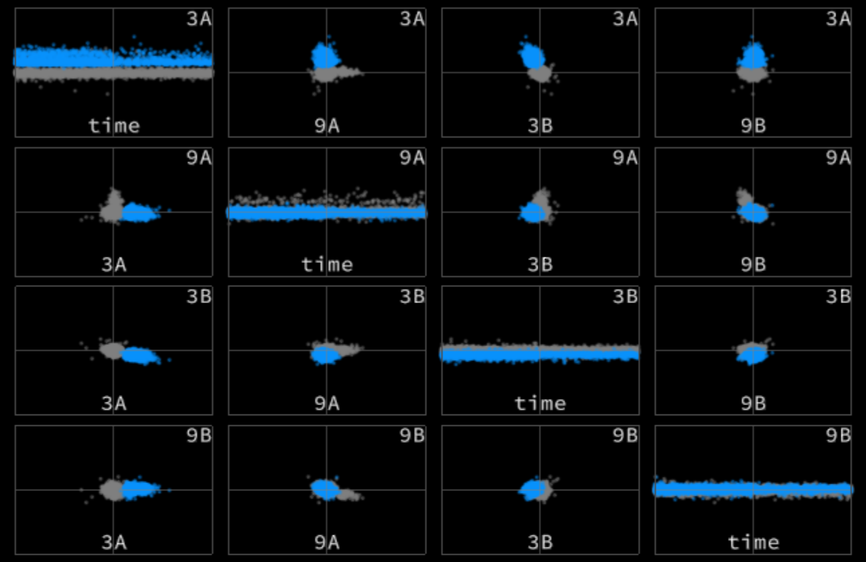
waveforms high_pass

AmplitudeView



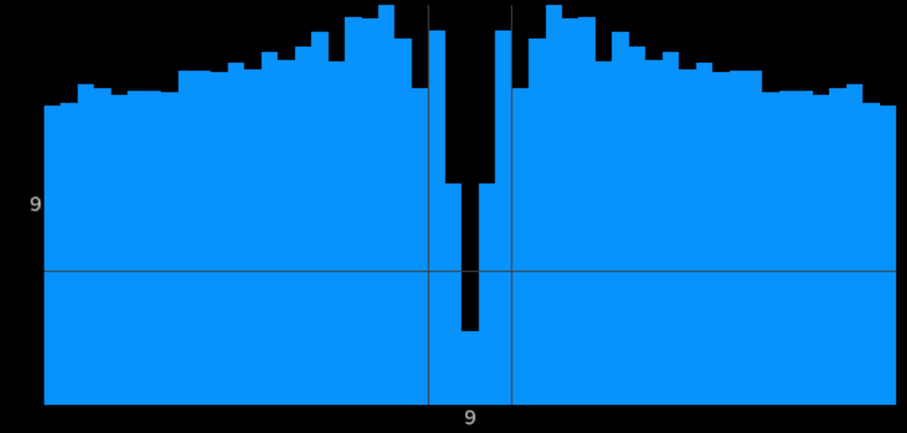
template

FeatureView



channels: 3, 9

CorrelogramView



50.0 ms (1.0 ms)

Undo cluster assign.

Attributions

(Slide 2,...) “Extended Data Fig. 1: Kilosort4 graphical user interface” in Pachitariu, M., Sridhar, S., Pennington, J. et al. Spike sorting with Kilosort4. Nat Methods 21, 914–921 (2024). https://doi.org/10.1038/s41592-024-02232-7 is licensed under CC 4.0

(Slide 2) “Fig. 2. Cortical discrimination in a cocktail party paradigm in mouse ACx” in Nocon, J.C., Gritton, H.J., James, N.M. et al. Parvalbumin neurons enhance temporal coding and reduce cortical noise in complex auditory scenes. Commun Biol 6, 751 (2023). https://doi.org/10.1038/s42003-023-05126-0 is licensed under CC 4.0

(Slide 2,...) Product images from https://www.tdt.com/system/32-channel-ephys-system/ are compiled under fair use for non-commercial, educational purposes.

(Slide 1,...) Rossant, C. R. GitHub - cortex-lab/phy: phy: interactive visualization and manual spike sorting of large-scale ephys data [Software]. In GitHub. (2015). https://github.com/cortex-lab/phy