Lessons Learned in Spike Sorting: The $n = 1$ Perspective

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June 21, 2013

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- March 2013–June 2013: Improving merge deliberation

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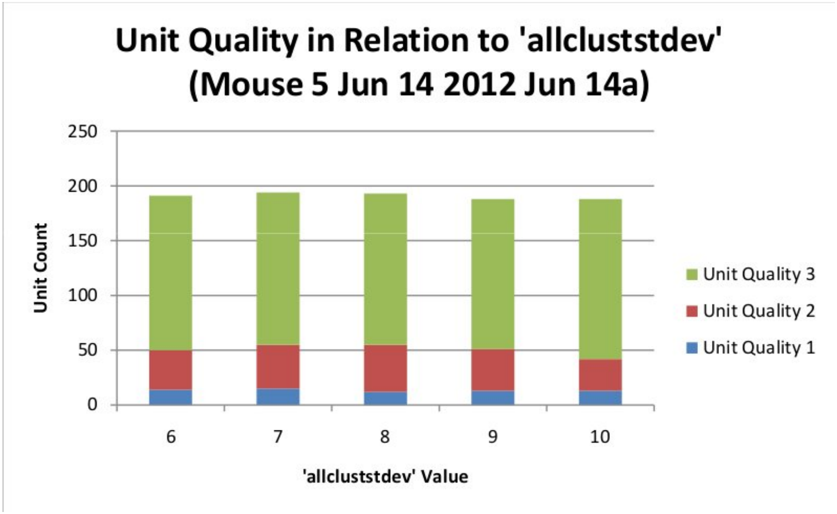
- Doing unit quality by hand on the same dataset again and again is tedious and prone to inconsistency

This Figure is Really Old (Mouse 5 Jun14a)



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   - Qualifier that works well: restricting consideration to points near the peak of the spike

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- Best use case for auto-unit quality?
  - Consistent scoring of different sorting algorithms

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- Observations
  - `get_penultimate` merges are usually not very significant
  - bulk of merges are done in `get_final_units`

Applying lessons learned with `mergecluststdev`: merges in `get_final_units`

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  1. ~~Mahalanobis Distance~~
  2. Principal Component Analysis

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- Principal component analysis (PCA) allows us to transform each spike into 47 components of decreasing significance, so a comparing e.g. only the first three dimensions becomes reasonable (we go from $\mathbb{R}^{47}$ to $\mathbb{R}^{3}$)

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  4. For the other unit **j**, also form cluster of points corresponding to spikes in $\mathbb{R}^3$
  5. Consider the distance between the clusters to decide if the two units should be merged (the smaller the distance between the clusters of two units, the more likely they should be merged)

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  - Use intensive garbage-discarding/“sanity-checks”—`get_sane` before the merge process

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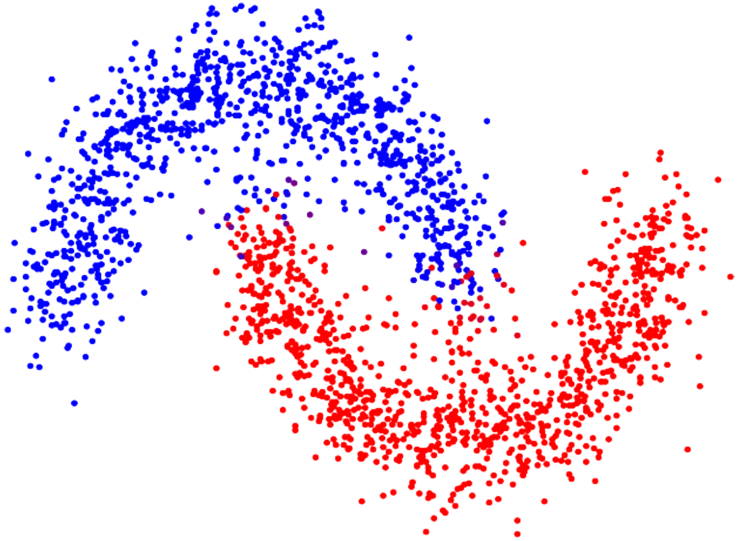

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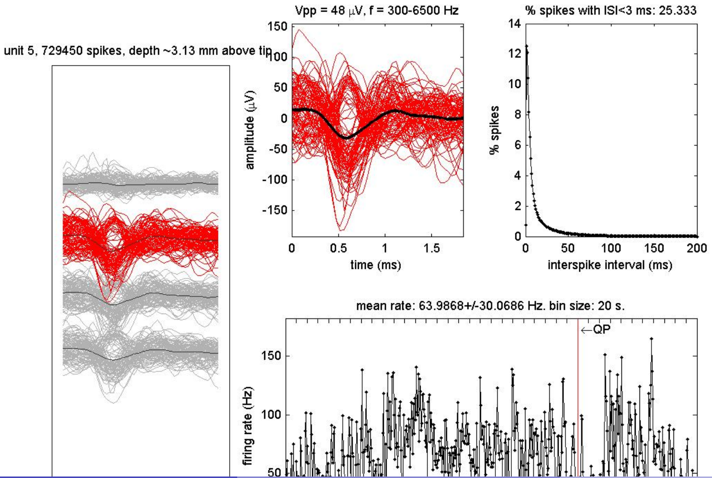

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4. If the peak-to-peak voltage of a unit is below a certain threshold, discard it
5. Take the coefficient of variation of the minimum of each unit: $\frac{\sigma}{\mu}$ and discard this unit if it exceeds a certain threshold

Performance with and without `get_sane` (Mouse 48) Evaluated Manually

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Process	get_sane,pca	get_sane,orig	orig	orig[1]

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Qual. 1	43	25	20	38
Qual. 2	59	40	38	62
Qual. 3	119	57	128	227
Total	221	122	186	327

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Process	get_sane,pca	pca	get_sane,orig	orig	orig [2]
Qual. 1	47	45	27	25	30
Qual. 2	67	75	38	28	64
Qual. 3	107	239	57	133	233
Total	221	359	122	186	327

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- The short answer is: very few.
- On a typical dataset (Mouse 48), **95%** - **98%** units are discarded
  - Why does get_sane still produces a comparable number of units with this many being discarded? It does not overmerge bad units.

Further Ideas

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  - *k*-means
  - spectral clustering

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- Unit Maturity

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- Consider scope and variable names carefully–avoid making everything globally accessible and naming conflicts and know what the state of each variable should be at every step