Eventer: Software you can train to detect spontaneous synaptic responses for you

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1. Poster Summary

The problem …

- Detection and analysis of spontaneous synaptic events is an extremely common task in many neuroscience research labs. Various algorithms and tools have been developed over the years to improve the sensitivity for detecting synaptic events.
- However, the final stages of most procedures for detecting synaptic events still involves manual selection of candidate events. This step in the analysis is laborious and requires care and attention to maintain consistency of event selection across the whole dataset. Manual selection can introduce bias and subjective selection criteria that cannot be shared with other labs simply in reporting methods.

The solution …

- To address this, we have created Eventer, a standalone application for the detection of spontaneous synaptic events acquired by electrophysiology or imaging. This opensource application uses the freely available MATLAB Runtime and can be deployed on Mac, Windows and Linux systems. The principle of the Eventer application is to learn the user's 'expert' strategy for classifying a set of detected event candidates from a small subset of the data, and then automatically apply the same criterion on the whole dataset.

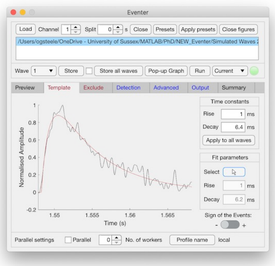
… but how?!

- Eventer uses a suitable model template to pull out event candidates using fast fourier transform (FFT)-based deconvolution. Random Forests are then trained to associate various features of the events with manual classification. The stored model file can be reloaded and used to analyse large datasets with greater consistency.

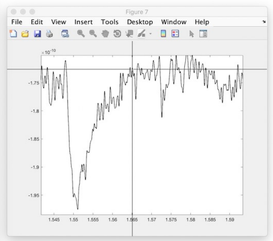
The impact …

- The eventer website (https://eventerneuro.netlify.app/) includes a repository where researchers can upload and share their machine learning model files and thereby provide greater opportunities for enhancing reproducibility when analysing datasets of spontaneous synaptic activity. In summary, Eventer, and the associated repository, could allow researchers studying synaptic transmission to increase throughput of their data analysis and address the increasing concerns of reproducibility in neuroscience research.

2. Eventer GUI



Can harness parallel processing



Easy to use interface

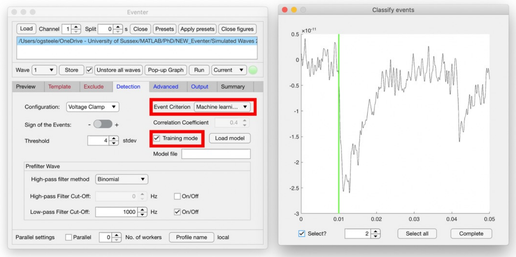
Eventer is software to detect spontaneous synaptic response

Based in MATLAB and open source. Distributed as MATLAB toolbox and free standalone app for:

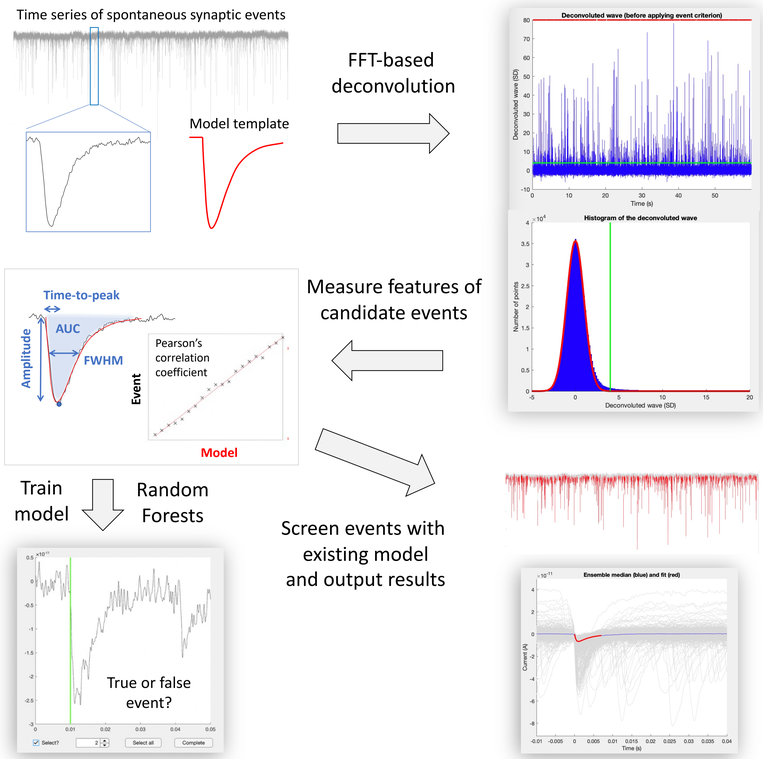
- Windows
- MacOS
- Linux

Can read binary and text file formats from a wide variety acquisition software

Detect synaptic events in time series data from electrophysiology and imaging



3. Event Detection



4. Performance: Speed & Accuracy

Performance test using simulated random events added to recording noise (blockers of glutamate and GABA receptors included)

Eventer used with a detection threshold of 3 standard deviations of the noise

$$\text{False Positive Rate (FPR)} = \frac{FP}{FP + TN}$$

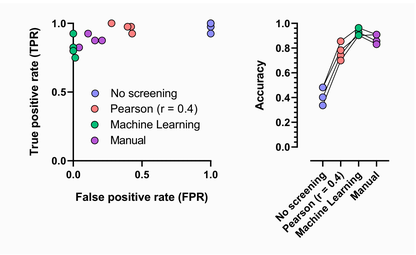
$$\text{True Positive Rate (TPR)} = \frac{TP}{TP + FN}$$

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

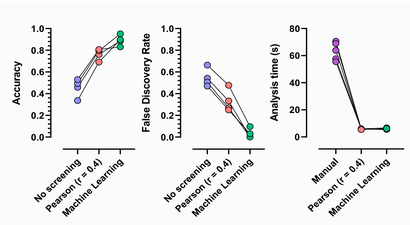
$$\text{False Discovery Rate} = \frac{FP}{FP + TP}$$

TP: True Positive **FP**: False Positive
TN: True Negative **FN**: False Negative

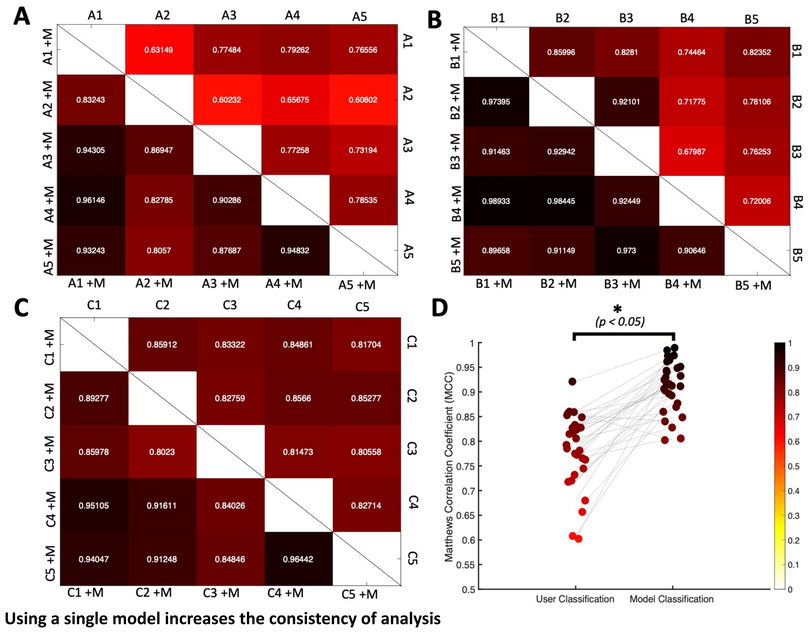
Eventer machine learning improves accuracy for detecting simulated events



Eventer machine learning is an effective substitute for manual event selection



5. Performance: Consistency



Using a single model increases the consistency of analysis

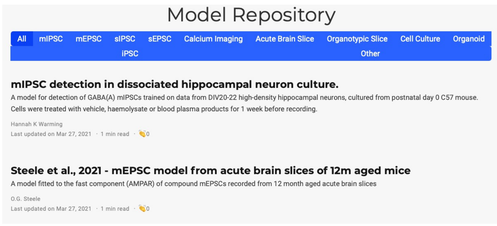
Three groups of researchers (**A-C**) were given separate recordings and asked to classify events as either true events or noise. Shown in the above-diagonals in plots **A-C** are Matthews Correlation Coefficient (MCC) scores of their classification to that of their peers. The analysis was then repeated using the same machine learning model, as displayed in the below-diagonal in **A-C**, and MCC scores increased. **D** then plots all scores across groups and revels a significant improvement in consistency ($p < 0.05$). Settings (e.g. event time constants) were left to the judgement of the individual, hence the MCC isn't 100% in model assisted tests.

6. Reproducibility

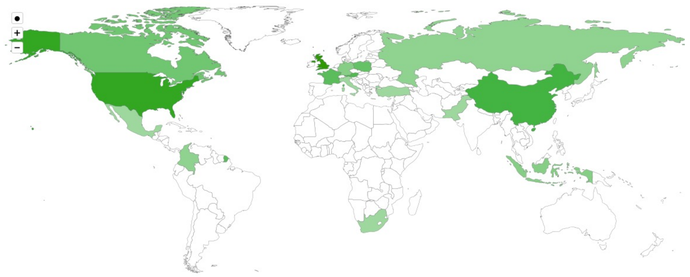
The lack of reproducibility of analysis plagues current science and by training a model to replicate your selection criteria this can then be replicated within lab – but also between labs.

Eventer has it's own 'model repository' to enable sharing of trained models in a range of preparations.

Check out the repository at eventerneuro.netlify.app/repository



Examples of models already submitted to the model repository



Eventer is already being used in the above countries – help us spread the word and address reproducibility in science!