

Online Supplementary Information: Description of database

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The mysql database contains filenames and other file data such as type of experiment, sequence, relation to other files, culture info and image/movie/audio/summary files available. Filenames and file information, but not patch or image data, are stored in the database. When a query is sent to the database it returns the names of the appropriate text files. Matlab then loads these files, containing data previously extracted from the .hdf files, and processes the data as instructed. A record of the query sent, the file names returned, and the time and date of the query is also automatically generated; this can be stored, off the printable area, of any figure made with the data from the filenames returned by the query as the accurate record each time a figure is modified. All experiments from Jan 1, 2005 through 2007 are included in the database except for the experiments for the NR2 project and the experiments on okadaic acids effects on release for the vesicle dynamics study. Any experiment deleted or not saved because seals were of very poor quality is also not represented in the database.

The database contains two tables, one for experiments and one for epochs. Experiments are defined as all recordings from a given neuron or pair of neurons, that is, as the files listed between slashes in the lab notebook. The primary key for patchlog_expts_table is first_patchlogfile_this_expt. The patchlog_epochs_table uses first_patchlogfile_this_expt (the foreign key), epoch_class_and_sequence and suffix as primary keys. Because some epochs include multiple patchlogfiles, the file names in patchlogfiles_this_epoch are enclosed within brackets to allow them to be separated and loaded within Matlab. Trials_to_ignore and suffix are enclosed within brackets as well for the same reason. In some cases, for example when the positive pressure is increased during a recording to a new set point, the same log file belongs to multiple epochs; the trials_to_ignore entry will allow the trials from a patchlogfile belonging to each epoch to be loaded. A few microperfusion recordings include two separate release sites reliably distinguishable by latency; these were analyzed and stored separately using a suffix such as _2to10ms and this is reflected in the table. The relationship of the expts table to the epochs table is one-to-many, but there are some expts that have only one matching epoch entry, and, when it is unlikely that a given experiment will ever be analyzed, sometimes the information is entered only into the expts table, not into the epochs table; these expts table entries thus have no matching epochs table entry.

Epochs table entries must have a corresponding entry in the experiments table. Each experiment in the experiments table is classed according to main and secondary stimulus class and main and secondary configuration. Allowed stimulus classes are:

- stdp (used as `expt_main_stimulus_class` when the induction is a useful part of the expt; hence roughly synonymous with `expt_free_of_significant_technical_problems` and `induction_can_be_measured` both being 1 – if stdp was attempted but these conditions are not met, stdp should be `expt_secondary_stimulus_class`)
- sd (used as `expt_main_stimulus_class` when that is the main focus of the expt; when stdp is the main stim class, the presence of useful sd information is implied. Any period of recording suitable for sd analysis is also suitable for rd and hd analysis)
- rrp
- reverb
- total_pool_size (local puffing with high K or sucrose)
- brief_tetanus_var_recovery
- test (during building the rig and working out staining, noise, camera, movie, etc.)
- network_ID
- minis_in_TTX
- truncated (when not even any SD is available)
- gaba_sd
- dopamine

As stated, whenever stdp is attempted, stdp is listed as the main stimulus class. In such experiments, when good trials exist but there are too few of them to measure stdp, `induction_can_be_measured` is 0. The sd from such experiments may still be valuable; when this is the case, `expt_secondary_stimulus_class` will be sd. When technical problems are present throughout enough of the experiment to make evaluation impossible, `expt_free_of_severe_technical_problems` is 0. This means the experiment yields no useful information. If `expt_main_stimulus_class` is stdp and `induction_can_be_measured` and `expt_free_of_severe_technical_problems` are both 1, then `expt_shows_induction` can be determined; if it is 1, then the experiment is a successful induction, and if it is zero, the experiment is a failure; either of these are suitable for charge transfer and related analyses. `expt_shows_LTP` can ultimately be quantified using t-tests. Within a potentially useful experiment, a bad epoch can be marked by setting `epoch_free_of_severe_technical_problems` to 0. Secondary stimulus class becomes important in situations where for example a brief train variable recovery (secondary class) experiment is done both before and after stdp (primary class). Because the vast majority of stdp experiments consist of sd, induction, sd, sd is not listed as a secondary stimulus class for these experiments. Secondary experiment class is used in situations such as RRP then sd characterization at the same bouton.

Configurations possible are:

macroperfusion Note: If macroperfusion is the `expt_main_configuration_class` and macroperfusion is listed as `expt_secondary_configuration_class`, that means there is something more

than M1 available from the macroperfusion recording period(s).

microperfusion

microperfusion_PPO (positive pressure only)

natural_oligobouton – these are essentially very small synapses under macroperfusion, so the two categories may be merged in the future as the cutoff is nebulous. These expts are useful for comparison to microperfusion expts for testing the effect of microperfusion on PSC waveforms.

dendritic_patch

Coded notes in the comment fields (Procedural notes and potential confounds in italics):

CannotBeUsed –

CBU – can be used (generally as part of a check statement).

CHECK –

ChgAsynch – suspected change in asynchronous release following induction

ChgAudio – suspected change in the audio signal over time

ChgAutapse – suspected change in autaptic responses

ChgExcit – induction seems to require less current to make the postsyn cell spike than was needed during a previous induction

ChgJitter –

ChgPotency –

ChgPr – suspected change in success rate

ChgProtocol – the experimental protocol was changed beginning with (or around the time of) this experiment

ChgRacc –

ChgSD – suspected change in short-term synaptic dynamics (with or without LTP)

ClumpedEvents – (generally during rrp type expts) successes in response to trains of APs tend to occur in a temporally nonrandom fashion

Clusterable – waveforms suggest suitability for clustering

CompareMacroMicro – waveforms in global and microperfusion Ca bear comparison

CtrlNoPosPressure – pos pressure was off for one or more trials to show that without it, release cant occur

DiffPuffLocations – over the course of the expt or epoch

DiffReleaseSitesCoOccur – more than one waveform seen with consistent latency. Latency should be included as a parameter when clustering. The dopamine expt is a great example. This differs from InterestingAsynch, MultiPeaks in that here the consistency of the two latencies really suggests two separate axonal paths within the stream.

DiffReleaseSitesOverTime – for example, the first 10 trials show PSC with latency of 5ms, then suddenly we see trials with a latency of 10ms for 10 trials – simplest explanation is pipette drift, but more interesting possibilities exist, especially if a given site (i.e. latency) disappears then reappears. Latency should be included as a parameter when clustering in these cases.

DiffSDAutSyn – suspected difference in the short-term dynamics at the autapse and the synapse

DoublePostsynSpike – during induction, the postsyn cell spikes twice

ElevBgrd – suspected elevation of background following induction

EstMPT – minutes per trial obtained from expt start/stop time

EventSizeShapeDendriticLocation – if the distance from the postsyn soma is known (because image of micropuff location is available), questions of the relation event size and rise time to dendritic distance can be addressed

FNP – fluctuating negative pressure is thought to have been a problem during that experiment

Frenzy – for lack of better term, one or both of the cells goes into a form of frenzy of tremendous activity

Garbage –

GlobalNormCaInduc – 3 mM Ca present globally during the induction

HD – history dependence

HighBgrd – high activity not related to stimulation or induction, a potential confound

HighFailureRate –

HighKUsed – generally for staining

ImgUseful – potentially useful image(s), possibly movies, associated with this file

InterestingAsynch – MultiPeaks is one type, waveforms frequently show two or more peaks with variable latencies, suggesting multiple vesicles being released asynchronously from one or more release sites

InterestingSD – Ufunction is one possible type, Monotonic [with IPI] is another

ITL_TS – inter-trial interval likely too short

LargeEventsAndFailures – At the same micropuff site, failures and large events alternate

LargeLateLTP –

LargeMicroperfArea – many sites could be exposed

LowCaLongLatency –

LTD – suspected

LTDBecomesLTP – suspected

LTP – suspected LTP (does not mean necessarily statistically proven)

Mixing – useful for technical evaluation of mixing between zero and 0.2 mM Ca, or between with/without CNQX

MultiBumpEPSP –

MultipleValsAPsPerTrial – more than one value of APs per trial exists in the epoch; should only have one

MVAM – multi-vesicle asynch a/o mini release, for questions of AP-independent coordination of release

NeedCrit (or Ctrl, Psclass, Raw, or INa) – need this information

NoHistoryDep – responses to third or fourth pulse show no clear correlation with earlier responses in the trial (this finding is strongest if there is dependence from o to a, and if b

or c show no trend over the expt either)

OverSpill – waveform suggests transmitter overflow and extrasynaptic activation

PostIndStun – suspected stunning (diminished responses for several minutes) after induction

PrCorrelatesWithinTrials –

ProbsINa – may have problems evoking the presynaptic AP

PSCaHypervariable – the second response in the train tends to have a huge variability, suggesting that after the first response the synapse state is poised between two widely divergent alternatives.

PSCb400 – shows large, consistent difference inPSCb50 and PSCb400, providing info on F/D

PTP – suspected post-induction potentiation

PuffingHighCa – microperfused [Ca⁺⁺] higher than the usual 3 mM

RD – release dependence at this synapse merits investigation

Redistribution –

SD – short-term synaptic dynamics

SDOfAsynch –

SDOfClusters – a given release site may be preferentially activated by a given stimulation history

SDOfJitter –

SDOfLatency –

SDOfPr – Facil is one type

SettingsChgDuringEpoch – the epoch is anisotropic in terms of pos or neg pressure, tip positions etc

ShortIPIDestabilizes – after a (very) short IPI, the responses to later APs are multi-peaked and choppy

StableBaseline – example of long, stable baseline

StrgWav – strange waveforms (Shoulder is one type, may be special case of DiffReleaseSitesCoOccur; VerySlow is another type, may be due to elevated R_{acc}, DecayBend is another type)

TargSpec – contains information for SD of E to I connections

TestCoop – multiple induction attempts at the same site differing in the number of boutons in the stream due to changes in pos pressure, as a means of testing cooperativity of stdp

TransposedCells – postsyn cell becomes presyn, presyn cell becomes postsyn

TrueSingleVes – a (putative) true single vesicle event

UnblockableCurrent –

Unquantized – data in the experiment are inconsistent with quantized responses

UnstableBaseline –

VariableLatency –

Each epoch in the epochs table is assigned a class, given by a letter:

M – macrosynaptic, single pulse tests of each cell to establish transmitter phenotype, generally before low calcium wash-in
L – loading of FM dye
C – characterization (reserved for stdp or sd expts, in either micro or macroperfusion)
Note: if stimulus_class is sd or stdp and config class is microperfusion, C1 is the first characterization epoch in microperfusion.
I – induction (in either micro or macroperfusion)
T – test
N – network
R – reverb
P – pool
S – search
F – facilitation and depression
X – minis in ttx
WC, WI – characterization or induction with the cells sWitched (presyn cell used as postsyn...)

Epochs are also assigned a number. Numbering is as follows: M1 is the macrosyn just prior to C1, which in turn is the characterization just prior to I1, the first induction. Immediately following I1 is C2. Earlier characterization epochs, with different microperfusion placements for example, are of the form Cneg1, Cneg2 with neg1 being the epoch just prior to the real first characterization epoch, going backward in time from that point. In epoch entries, information relevant to inductions is also storable, as a subset of epochs are inductions. pairing_special_circumstance is used when the formerly postsyn cell is used as presyn, for example. For stdp expts, info is returned from epochs C1 and C2 sharing the same first patchlogfile this expt, after checking that C1 and C2 both exist for that experiment. When trials_to_ignore or suffix are crucial in specifying epochs, these must be referenced in the query as well. To ensure filenames are consistently returned in the same order each time a query is sent, queries specify the ORDER BY portion of the return.

For an epoch to be marked free of significant technical problems, a) R_acc must be stable and moderate, b) no runup or rundown can be present, and seal quality must be high, c) presyn sodium current must be present all pulses, all trials (for meaningful analysis of success rate, release dependence, etc.), d) the psclass, crit, ctrl, raw and I_Na records for the patchlogfile(s) in that expt must have the same number of columns and be in register, and e) the epoch must have been mechanically stable and otherwise fine as far as is known.

Note on columns with numeric-type data: Null, rather than 0, should generally be the default value, as this permits distinction between no value entered and a value of zero. Recall that Matlab views Null as NaN. Related note, on yes/no situations: as mysql cannot

distinguish between No and Dont Know, yes/no situations should generally be represented with Numeric data, where 1 is yes, 0 is no, and Null is Dont Know (the default). Other considerations with regard to the database: give variables the same name in the database and in analysis files as much as possible; skipping a bad-seal trial during initial analysis in Matlab creates trouble later because the skip is handled differently by some saves than others (PSC, q etc. and controls save a zero column for the skipped trial, while raw and criterion do not).

An example of the query used to retrieve the preinduction baseline from STDP experiments (with curly brace replaced by exclamation point): [not shown]