This page describes the contents of a database of 1.7 million model neurons. The construction and analysis of the database are described in detail in (Prinz et al., 2003).

The database is available for interested researchers. Because of its size (over 6 GB even in the zipped version), it is not practicable to download the database over the internet. Instead, we have made multiple copies of the database on sets of two DVDs each.

**We are happy to send a set of DVDs to anybody who is interested upon e-mail request to prinz@brandeis.edu.**

On the DVDs, the database is organized in five folders. The content of the folders and the files they contain is described below. For questions, please e-mail to prinz@brandeis.edu.

# Contents of the database

All files in the database are ASCII files with spaces as column separators.

## Folder "neuron properties"

This folder contains 7 files that characterize all database neurons by giving their maximal membrane conductances, spontaneous activity type, spontaneous spike or burst frequency or resting potential, number of voltage maxima per burst, burst duration, phase response properties, activity type under current step injection, number of voltage maxima per burst during DC current injection, and more.

### File "conductancelevels.dat":

This file defines the maximal conductances of each neuron in the database. It has 9 columns and 1,679,616 lines. The columns are:

1) Model neuron number.
2) Conductance level for $I_{Na}$. Multiplied by 100 mS/cm$^2$, this number gives the maximal conductance density of $I_{Na}$ in this neuron.
3) Conductance level for $I_{CaT}$. Multiplied by 2.5 mS/cm$^2$, this number gives the maximal conductance density of $I_{CaT}$ in this neuron.
4) Conductance level for $I_{CaS}$. Multiplied by 2 mS/cm$^2$, this number gives the maximal conductance density of $I_{CaS}$ in this neuron.
5) Conductance level for $I_A$. Multiplied by 10 mS/cm$^2$, this number gives the maximal conductance density of $I_A$ in this neuron.
6) Conductance level for $I_{KCa}$. Multiplied by 5 mS/cm$^2$, this number gives the maximal conductance density of $I_{KCa}$ in this neuron.
7) Conductance level for $I_{Kd}$. Multiplied by 25 mS/cm$^2$, this number gives the maximal conductance density of $I_{Kd}$ in this neuron.
8) Conductance level for $I_H$. Multiplied by 0.01 mS/cm$^2$, this number gives the maximal conductance density of $I_H$ in this neuron.

9) Conductance level for $I_{leak}$. Multiplied by 0.01 mS/cm$^2$, this number gives the maximal conductance density of $I_{leak}$ in this neuron.

The conductance level file is often useful, but in a sense redundant, because the conductance levels can be directly calculated from the model neuron number. The conductance levels are the digits of (model neuron number – 1) in base 6, in the same order as the columns in the conductance level file. For example, to get the conductance levels of model neuron number 134,283, the decimal integer 134,282 has to be converted to base 6. The result is 2513402. This means that the conductance levels for model neuron number 134,283 are: 0 for $I_{Na}$, 2 for $I_{CaT}$, 5 for $I_{CaS}$, 1 for $I_A$, 3 for $I_{KCa}$, 4 for $I_{Kd}$, 0 for $I_H$, 2 for $I_{leak}$.

**File "spontaneous type periodorpotential minmaxnumber.dat":**

This file contains the classification results for the steady state spontaneous activity of all neurons. It has 4 columns and 1,679,616 lines. The columns are:

1) Model neuron number.
2) Integer number indicating the spontaneous activity type. 0 means silent, 1 means spiking, 2 means bursting, 3 means irregular.
3) For silent cells: resting potential in V. For spikers: spike period in s. For bursters: burst period in s. For irregular cells: average inter-maximum-interval in s.
4) Number of voltage minima and maxima stored in the corresponding minmax file for this neuron (see below).

**File "spontaneous burstduration maxperburst.dat":**

This file contains information about all bursters. It has 3 columns and 1,120,235 lines. The columns are:

1) Model neuron number.
2) Number of voltage maxima per burst for the regular bursters. An entry of 3333 in this column indicates that the model neuron is an irregular burster.
3) Burst duration (= burst period – largest inter-maximum-interval) in s. For irregular bursters, the entry is 0.

**File "PRC.dat":**

This file contains phase response curves (PRCs) for all regular bursters. The PRCs were simulated with a conductance pulse of 1,000 nS amplitude that lasted for 25% of the intrinsic burst period of the burster and had a reversal potential of -80 mV. The conductance pulse was delivered at phase increments of 0.1, starting at phase 0, which was assigned to the first voltage maximum in the burst.

The file has 12 columns and 1,065,225 lines. The columns are:

1) Model neuron number.

2) Burst period in s.
3) Phase response to a conductance pulse starting at phase 0.0.
4) Phase response to a conductance pulse starting at phase 0.1.
5) Phase response to a conductance pulse starting at phase 0.2.
6) Phase response to a conductance pulse starting at phase 0.3.
7) Phase response to a conductance pulse starting at phase 0.4.
8) Phase response to a conductance pulse starting at phase 0.5.
9) Phase response to a conductance pulse starting at phase 0.6.
10) Phase response to a conductance pulse starting at phase 0.7.
11) Phase response to a conductance pulse starting at phase 0.8.
12) Phase response to a conductance pulse starting at phase 0.9.

**File "injection types frequencies minmaxnumbers.dat":**

This file contains information about the response of each model neuron to injection of DC current steps from 0 nA to 3 nA and from 0 nA to 6 nA. It has 12 columns and 1,679,616 lines. The columns are:

1) Model neuron number.
2) Integer number indicating the spontaneous activity type. 0 means silent, 1 means spiking, 2 means bursting, 3 means irregular.
3) Integer number indicating the steady state activity type during 3 nA current injection. 0 means silent, 1 means tonically active, 2 means bursting, 3 means irregular.
4) Integer number indicating the steady state activity type during 6 nA current injection. 0 means silent, 1 means tonically active, 2 means bursting, 3 means irregular.
5) Spontaneous frequency of voltage maxima in Hz.
6) Steady state maxima frequency during 3 nA current injection in Hz.
7) Steady state maxima frequency during 6 nA current injection in Hz.
8) Number of voltage maxima during the first second after the injection current was stepped from 0 nA to 3 nA.
9) Number of voltage maxima during the first second after the injection current was stepped from 0 nA to 6 nA.
10) Number of spontaneous voltage maxima and minima stored in the corresponding injminmax file for this neuron (see below).
11) Number of voltage maxima and minima during 3 nA current injection stored in the corresponding injminmax file for this neuron.
12) Number of voltage maxima and minima during 6 nA current injection stored in the corresponding injminmax file for this neuron.

**File "injection 3nA maxperburst.dat":**

This file contains the number of voltage maxima per burst for all neurons that show steady state bursting during 3 nA current injection. It has 2 columns and 710,667 lines. The columns are:

1) Model neuron number.
2) Number of voltage maxima per burst for the neurons that show regular bursting during 3 nA current injection. An entry of 3333 in this column indicates that the model neuron is an irregular burster during 3 nA current injection.

**File "injection 6nA maxperburst.dat":**

This file contains the number of voltage maxima per burst for all neurons that show steady state bursting during 6 nA current injection. It has 2 columns and 554,915 lines. The columns are:

1) Model neuron number.
2) Number of voltage maxima per burst for the neurons that show regular bursting during 6 nA current injection. An entry of 3333 in this column indicates that the model neuron is an irregular burster during 6 nA current injection.

## Folder "dynamic variable snapshots"

This folder contains a snapshot of the 13 dynamic variables of each model neuron in the database. The snapshots were taken at the end of the simulation of spontaneous activity and completely characterize the state of each model neuron at a point on its limit cycle. After resetting all dynamic variables to the values stored in the snapshot, future simulations can start on the limit cycle and thus don't have to repeat the at times lengthy approach to limit cycle.

The snapshots are in order of increasing model number and are organized in files with 5,000 snapshots per file. The files are named ***to###_shots.dat, where *** is the model number of the first snapshot in the file and ### is the model number of the last snapshots in the file.

The snapshot files were zipped in groups of 20 files. The zip files are named ***to###_shots.zip, where *** is the model number of the first snapshot in the first snapshot file and ### is the model number of the last snapshot in the last snapshot file.
Each snapshot file has 14 columns and 5,000 lines. The columns are:

1) Model neuron number.
2) Snapshot membrane potential in V.
3) Snapshot intracellular calcium concentration in M.
4) Snapshot activation variable m for $I_{Na}$.
5) Snapshot inactivation variable h for $I_{Na}$.
6) Snapshot activation variable m for $I_{CaT}$.
7) Snapshot inactivation variable h for $I_{CaT}$.
8) Snapshot activation variable m for $I_{CaS}$.
9) Snapshot inactivation variable h for $I_{CaS}$.
10) Snapshot activation variable m for $I_A$.
11) Snapshot inactivation variable h for $I_A$.
12) Snapshot activation variable m for $I_{KCa}$.

13) Snapshot activation variable m for $I_{Kd}$.
14) Snapshot activation variable m for $I_H$.

Altogether, the folder contains 336 snapshot files compressed in 17 zip files.

## Folder "spontaneous activity patterns"

This folder contains trains of voltage maxima and minima during spontaneous steady state activity for each model neuron. These trains provide salient features of the spontaneous activity patterns of the neurons without taking up the prohibitive amount of memory that would be required if a complete voltage trace were saved for every neuron. The maxima and minima list for a spiking neuron contains 3 spike periods of maxima and minima. The list for a regular burster has 3 burst periods of maxima and minima. The list for an irregular burster contains all maxima and minima that were simulated for that neuron, but no more than 1,000 average burst periods. The list for an irregular neuron contains all maxima and minima that were simulated, but no more than 1,000 average inter-maximum-intervals. No lists are saved for silent neurons.

The maxima and minima lists are in order of increasing model number and are organized in files with up to 5,000 lists per file. The files are named ***to###_minmax.dat, where *** and ### give the range of model neuron numbers whose lists are in the file.

The minmax files were zipped in groups of 20 files. The zip files are named ***to###_minmax.zip, where *** and ### give the range of model neuron numbers whose lists are in the zip file.

In the minmax files, each list of minima and maxima is preceded by the corresponding model neuron number in a separate line. The list itself has 4 columns, namely:

1) Time of voltage maximum or minimum in s.
2) Voltage at peak or trough in V.
3) Integer number indicating whether the extremum is a maximum or minimum. 0 stands for a minimum, 1 for a maximum.
4) Value of the integer measure T at the time of the maximum or minimum (see **Prinz et al., 2003** for explanation).

Consecutive lists are separated by an empty line. Altogether, the folder contains 336 minmax files compressed in 17 zip files.

## Folder "current injection activity patterns"

This folder contains lists of voltage maxima and minima before and after injection current steps from 0 nA to 3 nA and from 0 nA to 6 nA for each model neuron. These lists provide salient features of each neuron's response to a current step and its bevavior during DC current injection without taking up the prohibitive amount of memory that would be required if a complete voltage trace were saved for every neuron.

Each list contains maxima and minima that occurred during the spontaneous activity before the current step, maxima and minima during the first second after the current step to 3 nA and the current step to 6 nA, and maxima and minima that occurred during steady state activity under 3 nA and 6 nA DC current injection. The current was stepped up at time 0 for each model neuron.

The maxima and minima lists are in order of increasing model number and are organized in files with 5,000 lists per file. The files are named ***to###_minmax.dat, where *** and ### give the range of model neuron numbers whose lists are in the file.

The minmax files were zipped in groups of 20 files. The zip files are named ***to###_minmax.zip, where *** and ### give the range of model neuron numbers whose lists are in the zip file.

In the minmax files, each list of minima and maxima is preceded by the corresponding model neuron number in a separate line. The list itself has 5 columns, namely:

1) Time of voltage maximum or minimum in s.
2) Voltage at peak or trough in V.
3) Integer number indicating whether the extremum is a maximum or minimum. 0 stands for a minimum, 1 for a maximum.
4) Value of the integer measure T at the time of the maximum or minimum (see **Prinz et al., 2003** for explanation).
5) Integer number indicating whether the extremum occurred during spontaneous activity before the current step (0), during 3 nA current injection (3), or during 6 nA current injection (6).

Consecutive lists are separated by an empty line. Altogether, the folder contains 336 injminmax files compressed in 17 zip files.

## Folder "simulator"

This folder contains an executable called simulator.exe that can simulate the spontaneous activity of any model neuron in the database. The executable is started by double-clicking on it. Further details are explained on the user interface that pops up when the program is started.