

# Neurosim User's Guide

version 2.1

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**To download this document and the neurosim program go to:**  
(<http://hornlab.neurobio.pitt.edu>)

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## Table of Contents

<b>Introduction and Installation.....</b>	<b>4</b>
<b>Getting started.....</b>	<b>5</b>
<i>Quick start.....</i>	<i>5</i>
<b>Menu selection.....</b>	<b>6</b>
<b>Diary function.....</b>	<b>6</b>
<b>Folder generation .....</b>	<b>8</b>
<i>Subfolders .....</i>	<i>8</i>
Template and data files .....	8
<b>Setting the total numerical integration time.....</b>	<b>9</b>
<b>Setting the number of secondary synapses .....</b>	<b>10</b>
<b>Setting the maximum synaptic conductance levels .....</b>	<b>11</b>
<i>Setting the primary synaptic conductance level.....</i>	<i>11</i>
<i>Setting the secondary synaptic conductance level.....</i>	<i>12</i>
<b>Setting the random seed source .....</b>	<b>12</b>
<i>Setting the random seed source for an individual template.....</i>	<i>13</i>
Using the system clock to set the random seed.....	13
Using user input to set the random seed .....	13
Using a random seed saved to file .....	14
<b>Setting the firing modes.....</b>	<b>14</b>
<i>Setting the firing mode for the primary synapse.....</i>	<i>15</i>
<i>Setting the firing mode for the secondary synapses.....</i>	<i>15</i>
<b>Setting the temporal resolution for saving data .....</b>	<b>16</b>
<b>Setting the duration of the settling time at the start of a run .....</b>	<b>17</b>
<b>Setting the window of summation template mode .....</b>	<b>17</b>
<b>Setting the amplitude of modulation of the firing frequency.....</b>	<b>18</b>
<b>Setting the rate of modulation of the firing frequency .....</b>	<b>18</b>
<b>Setting the phase of modulation of the firing frequencies.....</b>	<b>19</b>
<i>Setting the phase of modulation of the primary synapse .....</i>	<i>19</i>

*Setting the phase of modulation of the secondary synapses* ..... 20

**Setting the cell type** ..... 20

**Setting the segmental integration time**..... 21

**Saving simulation parameters** ..... 21

**Setting the source of the parameters**..... 22

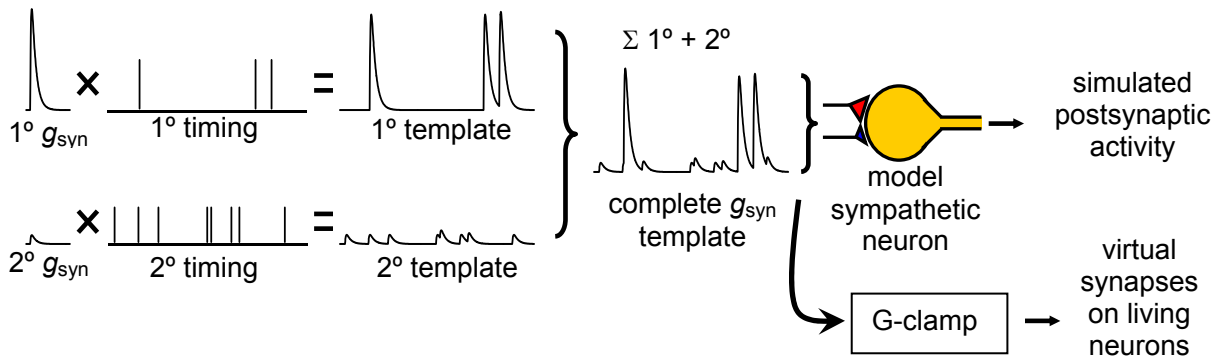
**Setting the synaptic conductance template source**..... 22

**Setting the header size** ..... 23

## Introduction and Installation

The `neurosim` software application implements a conductance-based model neuron with multiple synaptic inputs. The program will construct elaborate templates of synaptic activity describing the convergence of multiple synapses on one neuron. The templates can then be used to

- a) drive a conductance based model neuron and simulate postsynaptic integration
- b) drive the dynamic-clamp system known as G-clamp in recordings from living neurons



Both the model and G-clamp, which were designed for experiments to investigate synaptic integration in autonomic ganglia, are described more fully in the following two publications.

1. Kullmann, P.H.M., Wheeler, D.W., Beacom, J. and Horn, J.P.(2004) Implementation of a fast 16-bit dynamic clamp using LabVIEW-RT. **Journal of Neurophysiology**, 91: 542-554, 2004.
2. Wheeler, D.W. Kullmann, P.H.M.and Horn, J.P.(2004) Estimating use-dependent synaptic gain in autonomic ganglia by computational simulation and dynamic-clamp analysis. **Journal of Neurophysiology**, 92: (see supplemental material for a full listing of the conductance-based model).

`Neurosim` was written in the MATLAB programming environment (version 6.00.88, Release 12). MATLAB is a product of The Mathworks, Inc (Natick, MA, [www.mathworks.com](http://www.mathworks.com)).

**Running `neurosim` requires a licensed copy of MATLAB**, which can be obtained through your University or directly from the Mathworks. MATLAB is currently available as version 7, Release 14, service pack 2 and comes in editions that run either on the Windows or Unix

(including Mac OS X) operating systems. The ability to use `neurosim` is therefore platform-independent. However, numerical integration is computationally intensive and the time it takes to run simulations will vary with CPU speed. The Mathworks website contains further information on MATLAB system requirements and performance.

Download and Installation- `neurosim` is available on the Horn Lab website

(<http://hornlab.neurobio.pitt.edu>) as a packed winzip file called “neurosim-v2\_1.zip”.

Unpacking will produce a “`neurosim`” folder that contains 14 m-type MATLAB files. After starting MATLAB, make sure that the program can find the `neurosim` folder by pulling down the FILE menu to the SET PATH dialog and locating the folder. Once this is done you are ready to go.

## Getting started

`neurosim` can be run in three execution modes: 1) the program runs completely through all calculations, completes the conductance-based model simulations, and plots the results; 2) the program performs all of the calculations of the first mode but runs without plotting any of the results; 3) the program stops after computing the synaptic template and does not run the conductance-based model simulations.

To start the program, at the MATLAB prompt enter `neurosim<RETURN>`.

```
>> neurosim
```

```
Please input execution mode.
```

- 1: executes full ode computations
- 2: executes full ode computations without plotting
- 3: stops after synaptic conductance template is computed

```
Mode:
```

A menu with three options appears. For illustration, our tutorial focuses on the simplest option, the construction of a synaptic conductance template.

```
Enter 3<RETURN>.
```

## Quick start

A quicker way of starting is to enter `neurosim(3)<RETURN>`.

## Menu selection

In response to option 3, the program presents a menu selection of the parameters that control the generation of a template. Each parameter will be addressed in order.

Please enter a selection from the menu below (current values in parentheses):

- 1) Presynaptic firing frequency {favg} ([10.00] Hz)
- 2) Total numerical integration time {integTIMES} ([1000.00] ms)
- 3) Number of secondary synapses (9)
- 4) Maximum synaptic conductance levels {gsyn} ([100.000] 10.680\*[0.900  
0.900 0.900 0.900 0.900 0.900 0.900 0.900 0.900])
- 5) Random seed source (system clock: 207139)
- 6) Firing modes ([1][1 1 1 1 1 1 1 1])
- 7) Temporal resolution for saving data (0.25000 ms)
- 8) Duration of settling time at start of run (600.0 ms)
- 9) Tsum template mode (inactive)
- 10) Amplitude of modulation of the firing frequency {fosc} (0.00 Hz)
- 11) Rate of modulation of the firing frequency {fHR} (0.00 Hz)
- 12) Phase of modulation of the firing frequencies ([0.00] [0.00 0.00 0.00  
0.00 0.00 0.00 0.00 0.00 0.00] radians)
- 13) Neuron type (B)
- 14) Segmental integration time (50000.0 ms)
- 26) Save simulation parameters (none)
- 27) Source of the parameters (menu options)
- 28) Synaptic conductance template source (menu options)
- 29) Synaptic frequency modulator: sine wave
- 30) Facilitation: inactive
- 31) Number of bootstrap cycles (1)
- z) Run

Your selection:

To run a simulation with the default parameter settings, enter z<RETURN>.

Items 15-25 set the magnitude and reversal potential for each conductance in the model and the value of cell capacitance. These parameter selections can be accessed by entering execution modes 2 or 3 when first starting neurosim.

## Diary function

There is a diary function in MATLAB that saves all displayed text to a file, so neurosim displays a lot of information about the current state of the program for future reference. The program displays several parameter settings at the start of execution.

```
gCNG = 0 nS  gM_bar = 40 nS
```

The parameters gCNG and gM\_bar can be ignored since they do not affect a conductance template.

```
Fpre1 = 10.00 Hz  Fpre2 = 90.00 Hz
```

Fpre1, which has a default setting of 10 Hz, is the frequency at which the primary synapse fires. Fpre2 is the combined frequency at which all of the secondary synapses fire. In this instance, there are 9 secondary synapses each firing at a rate of 10 Hz, so the combined rate of firing of the secondary synapses is 90 Hz.

```
Integration Time = 1000.00 ms
```

The amount of time to be simulated is listed next.

```
Calling calc_pulse... 1:21:28 PM
```

The program next lists the functions that it calls and the times at which they were called. The function `calc_pulse` generates the number and the timings of all of the primary and secondary synaptic events.

```
11 primary pulses  
95 secondary pulses
```

The display lists the number of primary and secondary synaptic events.

```
Calling gsyn_template #1 of 1... 1:21:28 PM  
Template #1 done... 1:21:28 PM
```

The function `gsyn_template` uses the information generated in `calc_pulse` to assemble the actual conductance template. A properly-scaled conductance waveform is linearly added to the template for every event generated in the function `calc_pulse`. The default size for primary events is 100 nS, and the default for secondary events is 9.612 nS, which is 90% of the threshold value of 10.68 nS. For very long templates, the assembly of the template is broken up into parts, so the display also lists which section is currently being assembled. In this case, the template is only 1000 ms in duration, so there was only one section to assemble.

```
MATLAB Version 6.0.0.88 (R12).
```

```
Finis.
```

```
>>
```

Just before the program finishes, the display lists the version of MATLAB that is being used.

## Folder generation

Each time that `neurosim` is started, a new folder is generated for storing the output. The names of the folder is automatically generated and contains the date and the time at which `neurosim` was started. An example of a folder name is `session040503_13_36_35`. Inside the folder is a text file called `output.txt`, which contains all of the displayed text during the running of `neurosim`. Also inside is a subfolder that contains the generated conductance template and other information about the timings of the synaptic events.

## Subfolders

The subfolder name contains several of the parameter values used in generating the template. An example of a subfolder is `folder_40_0_10.0_90.000+0.0+0.0_phase0_gsyn0.90_tau1-5`.

The parameter values in order are the M-type potassium conductance (ignored), the cyclic nucleotide-gated cation leak conductance (ignored), the ideal firing frequency of the primary synapse, the ideal frequency of the combined secondary synapses, the amplitude of the oscillations in the firing rates of the synapses, the rate of the oscillations in the firing rates of the synapses, the phase of the oscillations in the firing rates of the synapses, the size of the secondary synaptic events with respect to the threshold synaptic conductance, and the rise time and fall time of the exponentials that describe each synaptic conductance waveform. Inside the subfolder are the conductance template file and assorted data files.

## Template and data files

Inside the subfolder are several files, which are tagged with the parameter values for the M-type potassium conductance (ignored), the cyclic nucleotide-gated cation leak conductance (ignored), the ideal firing frequency of the primary synapse, and the ideal frequency of the combined secondary synapses. The files that have the `dat` suffix are text files, and the `gtm` suffix signifies the conductance template files, which is a binary data file saved in IEEE floating point (single, 4 bytes) with big-endian byte ordering. There is a header in each `gtm` file that contains information about some of the parameters used to generate the template, which will be discussed in more



detail in a later section of the tutorial. The `dat` files contain the timings of all of the primary synaptic events, the intervals between the primary synaptic events, the timings of all of the combined secondary synaptic events, the intervals between the secondary synaptic events, and the state of the random number generator before the timings of all of the synaptic events were calculated.

## Setting the primary firing frequency

From the main menu enter 1<RETURN>.

```
Your selection: 1
```

```
The frequency at which primaries fire is [10.00] Hz.
```

```
Enter a new value or hit <RETURN>:
```

The program lists the current primary firing frequency in brackets. You may enter any value you wish or simply hit <RETURN> to return to the main menu without changing anything. You may enter several frequencies at once, and the program will produce a separate template for each frequency. Enter multiple frequencies by separating the values either by spaces 1 2 3, by commas 1,2,3, or by semi-colons 1;2;3. **!**Be careful not to mix spaces, commas, and semi-colons or the program may misinterpret your frequencies. The firing frequency of the combined secondary synapses will be automatically computed by the program based on the product of the primary firing frequency and the number of secondary synapses (main menu item #3).

The results of your selection are reflected in the updated main menu listing:

```
1) Primary firing frequency {favg} ([2.00 3.00 5.00] Hz)
```

## Setting the total numerical integration time

From the main menu enter 2<RETURN>.

```
Your selection: 2
```

```
The total numerical integration time is [1000.0] ms.
```

```
Enter a single negative number to have times  
automatically computed based on 400 primary synaptic firings.
```

Enter a new value or hit <RETURN>:

The program lists the current total numerical integration time in brackets. You may enter any value you wish or simply hit <RETURN> to return to the main menu without changing anything. If you have set multiple primary firing frequencies, you may also enter several integration times at once. Enter multiple integration times by separating the values either by spaces 1 2 3, by commas 1,2,3, or by semi-colons 1;2;3. **!**Be careful not to mix spaces, commas, and semi-colons or the program may misinterpret your integration times**!**

If you enter a negative number, then the program will automatically compute the amount of integration time needed to yield at least 400 postsynaptic action potentials (see Wheeler et al., 2004 for a more detailed description of counting errors associated with stochastically driven spike activity). For example, if the primary firing frequency is 5 Hz, then the integration time is 80000 ms. The automatic calculation is based on the primary firing frequency (main menu item #1) since it is assumed that each primary will always trigger an action potential. If you have set multiple primary firing frequencies, then the integration times corresponding to all of the frequencies will be automatically set.

The results of your selection are reflected in the updated main menu listing:

```
2) Total numerical integration time {integTIMES} ([200000.00 133334.00  
80000.00] ms)
```

## Setting the number of secondary synapses

From the main menu enter 3<RETURN>.

Your selection: 3

The number of secondary synapses is [9].

Enter a new value or hit <RETURN>:

The program lists the current number of secondary synapses in brackets. You may enter any value you wish or simply hit <RETURN> to return to the main menu without changing anything. The number entered will determine the secondary firing frequency. Instead of modeling 4

secondary synapses each firing at a frequency of 3 Hz, the program models a single secondary synapse firing at a frequency of 12 Hz.

The results of your selection are reflected in the updated main menu listing:

```
3) Number of secondary synapses (4)
```

## Setting the maximum synaptic conductance levels

From the main menu enter 4<RETURN>.

```
Your selection: 4
```

```
Please select a synaptic conductance to modify:
```

```
1) Maximum absolute primary conductance (100.000 nS)  
2) Maximum relative to a secondary conductance of 10.680 nS (0.900)  
z) Return to previous menu
```

```
Your selection:
```

From the synaptic conductance menu, you may modify the primary and secondary conductance levels. If you do not wish to make any changes, enter z<RETURN>.

The results of your selections are reflected in the updated main menu listing:

```
4) Maximum synaptic conductance levels {gsyn} ([100.000 (0.900*10.680)])
```

## Setting the primary synaptic conductance level

From the synaptic conductance menu enter 1<RETURN>.

```
Your selection: 1
```

```
Please enter a new value for the maximum absolute primary conductance or hit  
<RETURN>:
```

The maximum for the primary synaptic conductance is independent of the threshold conductance. If you wish to enter a value with respect to the threshold conductance, then enter a value such as 10\*10.68<RETURN>.

The results of your selection are reflected in the updated conductance menu listing:

1) Maximum absolute primary conductance (106.800 nS)

## Setting the secondary synaptic conductance level

From the synaptic conductance menu enter 2<RETURN>.

Your selection: 2

Please enter a new value for the maximum relative secondary conductance or hit <RETURN>:

The maximum for the secondary synaptic conductance is dependent on the threshold conductance. Enter a value that will be multiplied by the threshold conductance. For example, if you would like the secondary synaptic conductance to be 87% of the threshold conductance, then enter 0.87<RETURN>.

The results of your selection are reflected in the updated conductance menu listing:

2) Maximum relative to a secondary conductance of 10.680 nS (0.870)

## Setting the random seed source

From the main menu enter 5<RETURN>.

Your selection: 5

To modify a random seed source, please select from the menu below:

- 1) system clock: 208534
- 2) system clock: 209616
- z) Return to previous menu

Your selection:

If the program will be generating multiple templates (2 in this example), then for a particular template, you may modify the source that determines the seed for the random number generator.

If you do not wish to make any changes, enter z<RETURN>.

The results of your selections are reflected in the updated main menu listing:

5) Random seed source (system clock: 208534, system clock: 209616)

## Setting the random seed source for an individual template

In this example, the random seed source for the synaptic template #2 will be modified, so enter 2<RETURN>.

Your selection: 2

Please select a source for random seed #2 from the menu below:

- 1) System clock
- 2) User input
- 3) Read in from file
- z) Return to previous menu

Your selection:

For a particular template, you may modify the source that determines the seed for the random number generator. If you do not wish to make any changes to this template, enter z<RETURN>, and you will be returned to the random seed menu.

The results of your selections are reflected in the updated random seed menu listing:

2) system clock: 205895

## Using the system clock to set the random seed

To generate the seed for the random number generator from the system clock, enter 1<RETURN>.

Your selection: 1

The results of your selections are reflected in the updated random seed menu listing:

2) system clock: 205895

## Using user input to set the random seed

To use user input to set the seed for the random number generator, enter 2<RETURN>.

Your selection: 2

Please enter a number to initialize the state of the random number generator (will be rounded to nearest integer):

You may enter any value you wish as the seed for the random number generator. As an example, to set the seed to 2355, enter 2355<RETURN>.

The results of your selection are reflected in the updated main menu listing:

```
2) user input: 2355
```

### Using a random seed saved to file

To use a seed for the random number generator that was previously saved to a file, enter 3<RETURN>.

```
Your selection: 3
```

```
Name of file (default=rand_state10.0.dat) (type @ to abort):
```

**I**When entering the name of a random seed file, be certain that the file already exists**I** The default file name is based on the primary firing frequency of the current template. If you are satisfied with the default file, hit <RETURN>. If you want to enter a different filename, such as 'random\_seed.dat,' enter random\_seed.dat<RETURN>.

If you enter @<RETURN>, then you will be returned to the seed source menu for the current template. The results of any other selection are reflected in the updated random seed menu listing:

```
2) read from file: random_seed.dat
```

### Setting the firing modes

From the main menu enter 6<RETURN>.

```
Your selection: 6
```

```
Stochastic firing == +1  
No firing         == 0  
Steady firing     == -1
```

```
Please select a firing mode to modify:
```

```
1) Firing mode for primaries (1)  
2) Firing mode for secondaries ([1])  
z) Return to previous menu
```

```
Your selection:
```

The firing mode determines the pattern in which the synapses will fire. In the stochastic firing mode, synaptic firing is a Poisson process, and the intervals between synaptic events will be

distributed exponentially. In the no firing mode, the synapse is turned off, and there will be no synaptic events generated for that synapse. In the steady firing mode, the synapse will fire at a single set frequency, and the intervals between synaptic events will be all the same. If you do not wish to make any changes, enter `z<RETURN>`.

The results of your selections are reflected in the updated main menu listing:

```
6) Firing modes ([1][1])
```

### **Setting the firing mode for the primary synapse**

From the firing mode menu enter `1<RETURN>`.

```
Your selection: 1
```

```
Please enter a value for the firing mode for primaries or hit <RETURN>:
```

There are three options for setting the firing pattern for the primary synapse. If you do not wish to make any changes, hit `<RETURN>`.

Enter `+1<RETURN>` to set the stochastic firing mode. In this mode the firing of the primary synapse is a Poisson process, and the intervals between primary synaptic events are distributed exponentially.

Enter `0<RETURN>` to set the no firing mode. In this mode the firing of the primary synapse is turned off, and no primary synaptic events will be generated.

Enter `-1<RETURN>` to set the steady firing mode. In this mode the primary synapse fires at a set frequency, and the intervals between primary synaptic events are all the same.

The results of your selection are reflected in the updated firing mode menu listing:

```
1) Firing mode for primaries (1)
```

### **Setting the firing mode for the secondary synapses**

From the firing mode menu enter `2<RETURN>`.

Your selection: 2

Please enter a value for the firing mode for secondaries or hit <RETURN>:

There are three options for setting the firing pattern for the combined secondary synapses. If you do not wish to make any changes, hit <RETURN>.

Enter +1<RETURN> to set the stochastic firing mode. In this mode the firing of the combined secondary synapses is a Poisson process, and the intervals between secondary synaptic events are distributed exponentially.

Enter 0<RETURN> to set the no firing mode. In this mode the firing of the combined secondary synapses are turned off, and no secondary synaptic events will be generated.

Enter -1<RETURN> to set the steady firing mode. In this mode the combined secondary synapses fire at a set frequency, and the intervals between secondary synaptic events are all the same.

The results of your selection are reflected in the updated firing mode menu listing:

```
2) Firing mode for secondaries ([-1])
```

## Setting the temporal resolution for saving data

From the main menu enter 7<RETURN>.

Your selection: 7

Currently data will be saved every 0.25000 ms.

Enter a new value or hit <RETURN>:

This parameter determines the temporal resolution of the synaptic conductance template. It also determines how often the data from a simulation run is saved, but this will be ignored since this tutorial is only concerned with generating a conductance template. If you do not wish to make any changes, hit <RETURN>.



The results of your selection are reflected in the updated main menu listing:

```
7) Temporal resolution for saving data (0.25000 ms)
```

**ATTENTION G-CLAMP USER'S-** When constructing synaptic conductance templates for dynamic-clamp experiments, the temporal resolution of the template must match the speed of the G-clamp feedback loop. Example: To drive the dynamic clamp at 20 kHz, prepare a template with a temporal resolution of 0.05 ms.

## Setting the duration of the settling time at the start of a run

From the main menu enter 8<RETURN>.

```
Your selection: 8
```

```
Current value for the duration of the settling time is 600.0 ms.
```

```
This time allows the system to reach equilibrium before the synaptic firing begins.
```

```
Enter a new value or hit <RETURN>:
```

This parameter determines how long the system will be allowed to settle before synaptic activity begins. For example, if you want to allow the system to settle for 547.3 ms, enter 547.3<RETURN>. If you do not wish to make any changes, hit <RETURN>.

The results of your selection are reflected in the updated main menu listing:

```
8) Duration of settling time at start of run (547.3 ms)
```

## Setting the window of summation template mode

From the main menu enter 9<RETURN>.

```
Your selection: 9
```

```
The tsum template mode is currently inactive. Please make a selection from the menu below:
```

- 1) Make the tsum template mode active (2 primary pulses)
- 2) Make the tsum template mode active (1 primary & 1 secondary pulse)
- 3) Make the tsum template mode inactive
- z) Return to previous menu

```
Your selection:
```

The tsum template mode is used to generate a synaptic conductance template that consists of only two synaptic events. In the first mode, two primary events are generated. In the second mode, a primary event is followed by a secondary event. The third menu option inactivates the tsum template mode. Be advised that tsum template mode only works when the synapses are in steady firing mode (main menu setting #6). If you do not wish to make any changes, enter z<RETURN>.

The results of your selection are reflected in the updated main menu listing:

```
9) Tsum template mode (active (mode 1))
```

## Setting the amplitude of modulation of the firing frequency

From the main menu enter 10<RETURN>.

```
Your selection: 10
```

```
The amplitude of the firing frequency oscillations (fosc) is 0.0 Hz.
```

```
This parameter is used to sinusoidally modulate the synaptic firing frequency through a range of values.
```

```
Enter a new value or hit <RETURN>:
```

The program lists the current oscillation amplitude. You may enter any value you wish or simply hit <RETURN> to return to the main menu without changing anything.

The results of your selection are reflected in the updated main menu listing:

```
10) Amplitude of modulation of the firing frequency {fosc} (0.00 Hz)
```

## Setting the rate of modulation of the firing frequency

From the main menu enter 11<RETURN>.

```
Your selection: 11
```

```
The rate of the firing frequency oscillations (fHR) is 0.0 Hz.
```

```
This parameter is used to sinusoidally modulate the synaptic firing frequency through a range of values.
```

```
Enter a new value or hit <RETURN>:
```

The program lists the current oscillation frequency. You may enter any value you wish or simply hit <RETURN> to return to the main menu without changing anything.

The results of your selection are reflected in the updated main menu listing:

```
11) Rate of modulation of the firing frequency {fHR} (0.00 Hz)
```

## Setting the phase of modulation of the firing frequencies

From the main menu enter 12<RETURN>.

```
Your selection: 12
```

```
Please select a frequency phase shift to modify:
```

- 1) Phase shift of primaries' firing frequency (0.00 rad)
- 2) Phase shift of secondaries' firing frequency (0.00 rad)
- z) Return to previous menu

```
Your selection:
```

The program lists the current phase shifts for the primary and combined secondary synapses. If you do not wish to make any changes, enter z<RETURN>.

The results of your selection are reflected in the updated main menu listing:

```
12) Phase of modulation of the firing frequencies ([1.00 -12.00] radians)
```

## Setting the phase of modulation of the primary synapse

From the modulation phase menu enter 1<RETURN>.

```
Your selection: 1
```

```
Positive values correspond to a delay or right shift,  
negative values to an advancement or left shift.
```

```
Please enter a value for the primaries' phase shift or hit <RETURN>:
```

**!** Notice that the phase should be in radians **!** You may enter any value you wish or simply hit <RETURN> to return to the modulation phase menu without changing anything.

The results of your selection are reflected in the updated modulation phase menu listing:

1) Phase shift of primaries' firing frequency (1.00 rad)

## Setting the phase of modulation of the secondary synapses

From the modulation phase menu enter 2<RETURN>.

Your selection: 2

Positive values correspond to a delay or right shift,  
negative values to an advancement or left shift.

Please enter a value for the secondaries' phase shift or hit <RETURN>:

**!**Notice that the phase should be in radians**!** You may enter any value you wish or simply hit <RETURN> to return to the modulation phase menu without changing anything.

The results of your selection are reflected in the updated modulation phase menu listing:

2) Phase shift of secondaries' firing frequency (-12.00 rad)

## Setting the cell type

From the main menu enter 13<RETURN>.

Your selection: 13

Select a cell type to be modeled (B/C/D/E/M/R/S) or hit <RETURN>:

You may enter the cell type in either upper or lower case. If you do not wish to make any changes, hit <RETURN>. Entering a new cell type calls up a menu for adjusting the parameters that define a cell type.

Please select a B-cell parameter to modify:

1) Rise-time constant for the nicotinic synaptic conductance pulse (1.00)  
ms  
2) First fall-time constant for the nicotinic synaptic conductance pulse  
(5.00) ms  
3) Second fall-time constant for the nicotinic synaptic conductance pulse  
(0.00) ms  
4) Threshold nicotinic synaptic conductance (10.680)  
5) Nicotinic synaptic conductance pulse scaling constant (0.5349850000)  
z) Return to main menu

Your selection:

After you have finished changing the cell parameters, or if you do not wish to make any changes, enter `z<RETURN>`.

The results of your selection are reflected in the updated main menu listing:

```
13) Cell type (C)
```

## Setting the segmental integration time

From the main menu enter `14<RETURN>`.

```
Your selection: 14
```

```
Current value for the segmental integration time is 50000.0 ms.
```

```
This parameter is used to break up long integrations into more manageable segments.
```

```
Enter a new value or hit <RETURN>:
```

A segmentation length of 50000 ms or less should not cause any system memory problems. You may have to try several lengths in order to figure out what your system can handle. If you do not wish to make any changes, hit `<RETURN>`.

The results of your selection are reflected in the updated main menu listing:

```
14) Segmental integration time (25000.0 ms)
```

## Saving simulation parameters

From the main menu enter `26<RETURN>`.

```
Your selection: 26
```

```
Please enter the name of a file to which to write the simulation parameters.
```

```
Name of parameter file (default=params.mat) (type @ to abort):
```

If you are satisfied with the default file, hit `<RETURN>`. If you want to enter a different filename, such as '5Hz\_parameters.mat,' enter `5Hz_parameters.mat<RETURN>`. **Be sure to use the .mat suffix, which indicates a particular MATLAB® file type for parameters!**

If you enter @<RETURN>, then you will be returned to the main menu. The results of any other selection are reflected in the updated main menu listing:

```
26) Save simulation parameters (5Hz_parameters.mat)
```

## Setting the source of the parameters

From the main menu enter 27<RETURN>.

```
Your selection: 27
```

Please select a source for the simulation parameters from the menu below:

- 1) menu options
- 2) parameter file
- z) Return to previous menu

```
Your selection:
```

You may select the source of the simulation parameters to be either from the main menu selections or from parameter values saved to file. Selecting `menu options` returns you to the main menu. If you do not wish to make any changes, enter `z<RETURN>`. If you wish to load in parameter values from a saved file, you will be prompted for a filename.

```
Your selection: 2
```

```
Name of parameter file (default=params.mat) (type @ to abort):
```

**|** When entering the name of a parameter file, be certain that the file already exists **|** If you are satisfied with the default file, hit <RETURN>. If you want to enter a different filename, such as '2pulse\_parameters.mat,' enter `2pulse_parameters.mat<RETURN>`.

If you enter @<RETURN>, then you will be returned to the main menu. The results of any other selection are reflected in the updated random seed menu listing:

```
27) Source of the parameters (parameter file: 2pulse_parameters.mat)
```

## Setting the synaptic conductance template source

From the main menu enter 28<RETURN>.

```
Your selection: 28
```

Please select a source for the nicotinic synaptic conductance template from the menu below:

- 1) menu options
- 2) binary file
- z) Return to previous menu

Your selection:

You may select the source of the synaptic conductance template to be either from the main menu selections or from a template saved to file. Selecting `menu options` returns you to the main menu. If you do not wish to make any changes, enter `z<RETURN>`. If you wish to load in a conductance template from a saved file, you will be prompted for a filename.

Your selection: 2

Name of binary file (default=gsyn.gtm) (type @ to abort):

**I**When entering the name of a conductance template file, be certain that the file already exists**I** If you are satisfied with the default file, hit `<RETURN>`. If you want to enter a different filename, such as '3.7Hz.gtm,' enter `3.7Hz.gtm<RETURN>`. **I**The LabVIEW program G-Clamp recognizes synaptic conductance template files by the `.gtm` suffix**I**

If you enter `@<RETURN>`, then you will be returned to the main menu. The results of any other selection are reflected in the updated random seed menu listing:

28) Synaptic conductance template source (binary file: 3.7Hz.gtm)

## Setting the header size

From the main menu enter `28<RETURN>`.

Your selection: 28

The current size of the template header is 19 single floating-point numbers (76 bytes).

Please select a header size from the menu below:

- 1) 19
- 2) 128
- z) Return to previous menu

Your selection:

Select a header size, or if you do not wish to make any changes, enter z<RETURN>. This menu option will soon be phased out.

The results of your selection are reflected in the updated main menu listing:

```
29) Header size (128 single floats = 512 bytes)
```