

Using the Plot Tool

This program is for displaying 2 or 3D time series or limit cycle plots of the output of the 3 loop Arabidopsis model (Locke *et al.*, 2005). The simulations can be dynamically altered to illustrate the effect of varying the model or environmental parameters.

To use the program, first place 'locke_05b_plot.m', 'locke_05b.prm', 'locke_05b.sts' and 'Settings.set' in the same folder. If it did not happen automatically when you unzipped the archive, create a sub-folder called 'Parameters', and place 'Default.pv' in here. This file contains the default model parameters. Create another sub-folder called 'Environment' and place 'Default.env' in here. This file defines the cycle period and daylength. The program can now be run by simply typing 'locke_05b_plot' at the MATLAB command prompt.

The user interface is divided into three parts. The left column allows the user to choose the environment and parameters files. One of each is supplied as above, but the user can create more using [Circadian Modelling](#), which can then be copied to the same folders as the default files.

Below these files the user can set the 'Style'. Here there are 4 options:

1. 2D Time series. X axis is set to time. Select which outputs you wish to display from the 'Y axis' list. Use CTRL + Click to select multiple outputs.
2. 3D Time series. X axis is set to time. Select outputs from the Y and Z axis lists.
3. 2D Limit cycle. Select 2 outputs to plot against each other from the X and Y axis lists.
4. 3D Limit cycle. Select 3 outputs to plot against each other from the X, Y and Z axis lists.

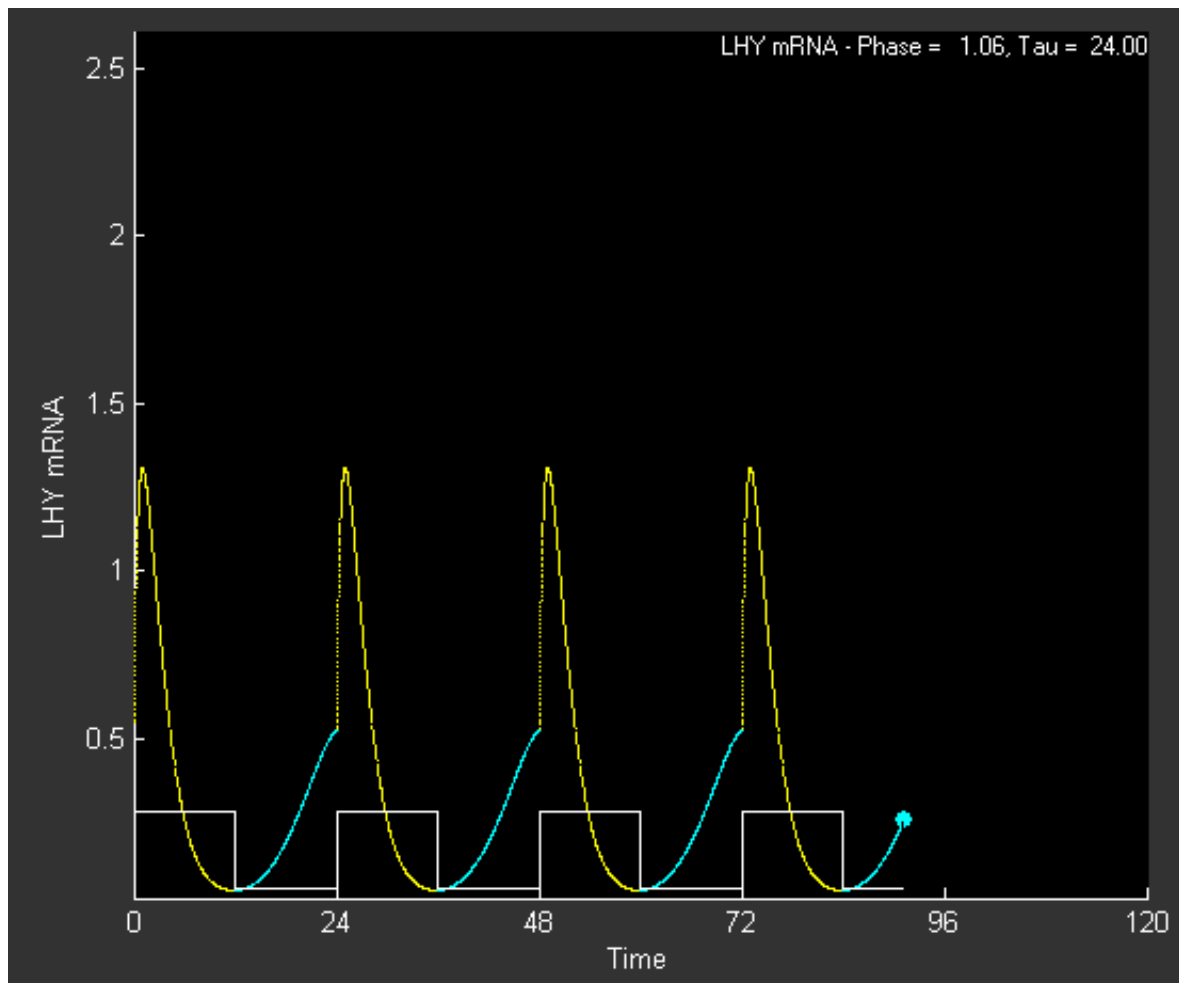
Below this are 4 buttons. These are play, pause, stop and record.

The right column of the user interface is used to alter the model and environment parameters, either before starting a simulation, or dynamically during a simulation.

The 'Environment' box contains a list of all environmental factors in the model. In the case of this model there is only one, white light, called 'White'. The button next to this list labelled 'P' toggles plotting of the light cycle on and off (available only in Time series mode). The list below displays all the environmental parameters, with their values. To alter one of these, select it with the mouse. Its value will then appear in the box below the list. You can then either type a new value or use the adjacent arrow buttons to increment or decrement the value. The 'D' button next to the '>' arrow restores the default value for the selected parameter. Any change is not applied however, until the 'Apply' button is clicked. The new value then appears next to its name. This is to allow a desired change at a very specific time during a simulation. The 'Pulse' button applies a light pulse when clicked during a simulation that is in a period of darkness. This allows an instant visualisation of the effect. The size and length of the pulse are defined in the list above.

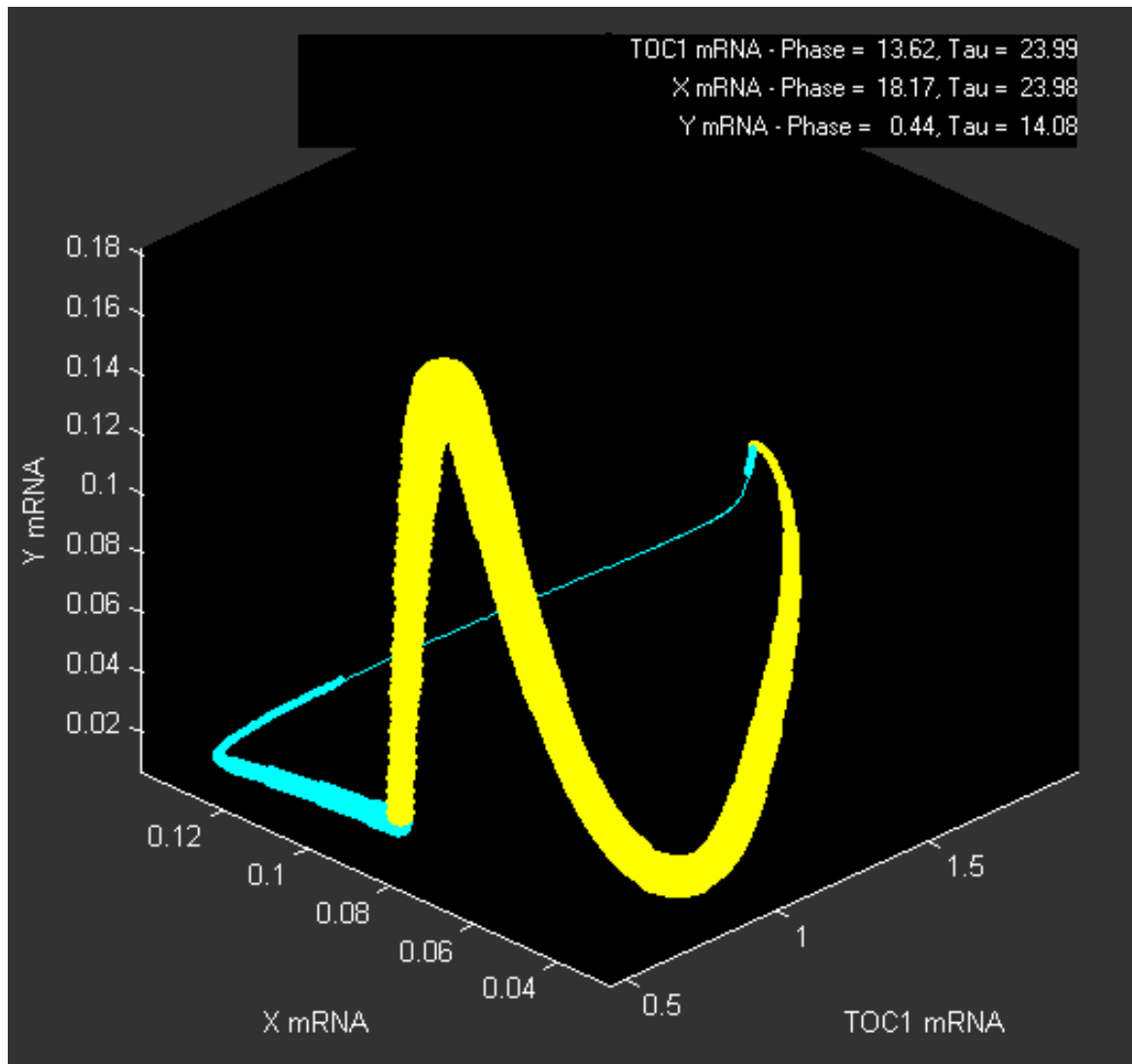
The 'Parameters' box contains a list of all the model parameters. These can be altered like the environment parameters, either before or during a simulation. You can select the desired parameter, enter a new value, and click 'Apply'. Again 'D' restores the default value to the parameter after 'Apply' is clicked. In this case the arrow buttons apply an increment/decrement of 10% of the default value for the selected parameter.

To begin a simulation, click the play button in the bottom left corner. The axes will now appear. The selected output will be plotted in yellow for periods of light, and cyan for periods of darkness as shown below. An exception to this is a 2D Time series with multiple outputs selected. In this case each will appear in its own colour.



The white square wave is the L:D cycle, which can be switched on and off as described above. The legend at the top shows the phase and period of each selected output. This can be switched on and off using the 'Plot' menu, as can the marker showing the latest position of the simulation.

When in 3D mode, the size of the marker represents its distance from the observer, taking into account the current orientation of the axes. For example, in the 3D limit cycle below the size the marker had at each point on the cycle is illustrated.



The 'scale' buttons below the axes are for changing the axis scales and are used as follows. Firstly, select from the list the axis you wish to change, X, Y, Z or All. Now click 'E' to enlarge the selected axis. This expands the axis by two. 'R' reduces the selected axis by 2. 'Auto' attempts to scale the selected axis to fit the data. This works by looking at the last two cycle periods worth of data to determine the maximum and minimum values. An exception to this is the time axis, which is not affected by 'Auto'.

The 'speed' slider simply alters the speed at which the simulation is run, by changing the error tolerance of the equation solver and the frequency at which the plot is updated. At higher speeds the plot is less accurate.

The record button is to allow users to make their own pre-recorded simulations in the form of an avi file. Click the record button, either before or during a simulation, which should then turn red to indicate record mode. When you wish to stop recording, click record again or click stop to end the simulation. A new file called 'recordingXX.avi' will then be created in the program folder.

Note that in order to preserve the frame size, it is essential not to re-size the border whilst recording.

Note that the speed of the simulation slows down considerably whilst recording. This is due to high demand on the CPU. In theory, the user is meant to be able to dynamically alter the model parameters and environment during recording, as during normal play mode. However, in our experience due to the high demand on the CPU the controls become unresponsive, and the program can occasionally crash. It may work well though on a very fast machine (ours is 2GHz, 1Gb RAM). There is also a delay of up to several minutes when stopping the simulation after having made a recording as the avi file is created.

The menu and toolbar displayed will be the standard figure menu and toolbar for which ever version of Matlab you are using. The most useful function is the rotate3D button. This allows the user to drag the orientation of the axes to any position they wish.