Shapeshifter User Manual

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Contents

Overview

Background irradiation

The “mean” intensity of the screen is set in the values in the “ ackground" data fields, the red blue and green guns can be set independently. The input is 0 to 255. The I/O relationship of your hard ware should be measured!

Stimulus space

The space in which Shapeshifter draws stimuli is a square box that is centred over the centre of your display. The stimulus space measures h x h pixels, where h is the height of your display, this value is measured and displayed in the "Num Pixels” box in the start panel. Note, the horizontal edges of your display are not used.

Stimulus types

Three types of temporal stimuli are supported.
1: Presentation of a shape for a defined time at a fixed location: "Constant tick box"
2: Presentation of a fixed shape at a fixed location but with changing contrast: “Flicker tick box"
3: Presentation of a moving shape with a fixed contrast: “Motion tick box"

Stimulus shape and position

With the Bar tick box selected you define the size of the bar in pixels using the "width" and “height" data fields under the appropriate epoch. The orientation of the bar is defined in degrees by the “angle" data field. The "Start/Location” data field defines the location on the axis defined in “angle” at which the bar will appear. 0 will make the bar appear at the edge of the screen, height/2 will put the bar in the centre of the screen and h will place the bar at the opposite edge. The value of “Start/Location" is in pixels and defines the centre

of the bar.

Stimulus contrast
The contrast of the bar is defined by the “Contrast1” data field. -1 will give -100% contrast and +1 will give +100% contrast.

Synchronisation
A Labjack DAC is used to send out TTL pulses to trigger acquisition and to signal stimulus presentations.

Installation
Mac OSX
1. Install matlab. (doesn’t matter if its 32 or 64 bit)
2. Install psychophysics toolbox (http://psychtoolbox.org/PsychtoolboxDownload)
3. Place the shapeshifter folder in the Matlab directory and add it to the matlab path.
4. Install labjack drivers (http://labjack.com/u3)
5. make sure you have Xcode with gcc-compilers, Xcode 4.6.3. (Xcode 5 does not have gcc-compilers)
6. Install home brew by pasting the line below into a terminal window

```
ruby -e "$(curl -fsSL https://raw.github.com/Homebrew/homebrew/go/install)"
```

7. Use home brew to install the libraries in their correct places, paste the following into the terminal

```
brew install libusb exodriver --universal
```

8. put the labjack.m file in your matlab folder along with the shapeshifter.m and .fig

Wiring
Connect the labjack, with the supplied USB cable, to the computer running shapeshifter.

For the trigger out: Strip one end of a BNC cable and connect it to a free FIO and ground it, label this output as trigger and update the Shapeshifter variable “LJtrig” with the number of the FIO close to the start of the "shapesifter.m" file

For the Screen out: Strip one end of a BNC cable and connect it to a free FIO and ground it, label this output as Screen and update the Shapeshifter variable “LJscreen” with the number of the FIO close to the start of the "shapesifter.m" file

Description of the panel buttons
Start
Starts shapeshifter by opening a window on your secondary display i.e. the projector/stimulus screen with an intensity defined by the background RGB data fields. Shapeshifter will also read the height of you display in pixels and the refresh rate, which are then displayed below the start button. **NOTE make sure you have a second screen setup, other wise shapeshifter will take over your main display!**

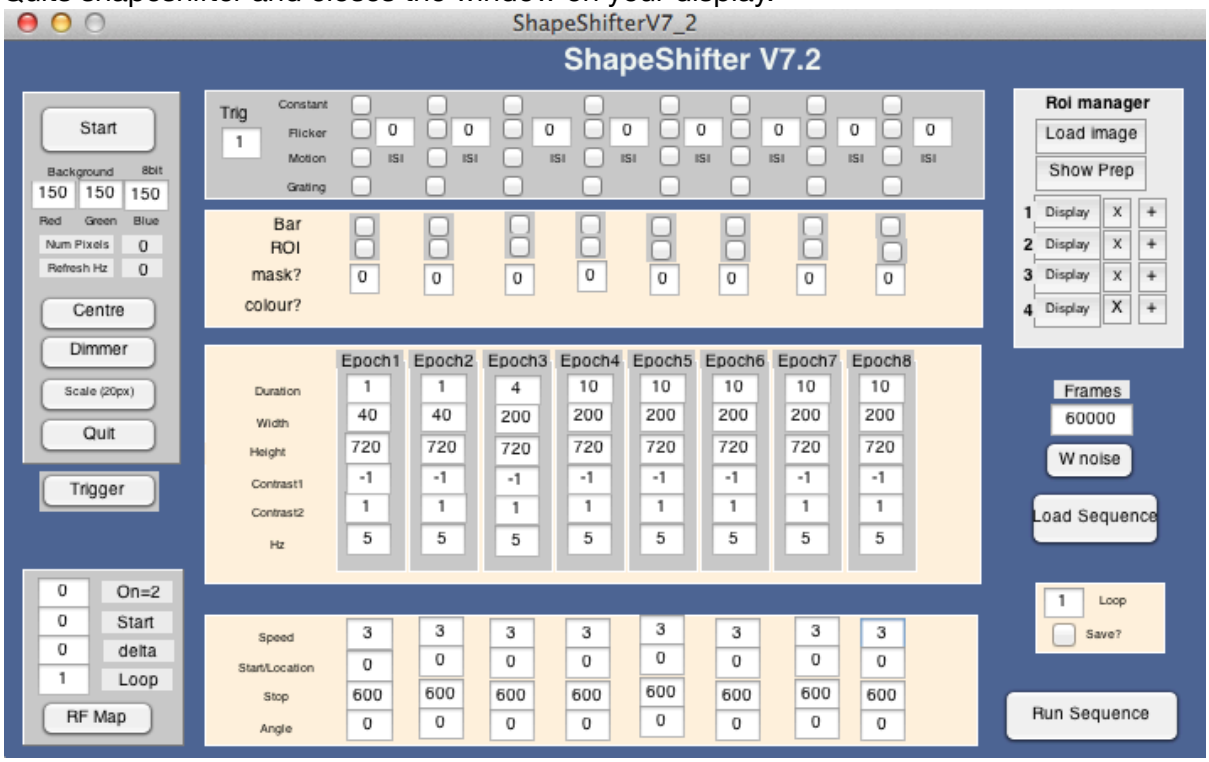
Centre
Provides a bright X on the screen indicating the centre, useful for aligning the screen.

Dimmer

Dims the screen. When un-ticked the screen will update with whatever values are in the RGB data fields.

Scale
Displays a 20 pixel long arrow on the screen, useful for calibrating pixels size.

Quit
Quits shapeshifter and closes the window on your display.



Trigger
Sends out a trigger pulse, without doing anything else.

RF Map
Starts a FBP receptive field mapping protocol

W noise
Plays a precompiled white noise movie for the number of frames shown in the "Frames" data field. The move should be named “m.mat” and be in the current Matlab directory.

Load Sequence
Loads all the data fields and tick boxes from stored protocols, see save tick box. Note, RF Map fields are not saved or loaded.

Loop data field
Input the number of times the stimulation sequence should be presented.

Save tick box
After presentation of a stimulus all stimulus parameters will be saved if this checkbox is ticked. Opens a dialog to ask for a save location and file name. Note, does not save RF variables.

Run Sequence
Runs the currently loaded sequence

Designing stimuli

The following examples assume a display size of 1280x720 pixels. Bear this in mind while performing the examples

Example 1. After 3 seconds of baseline display a -100% box measuring 50 x 50 pixels in the centre of the screen for 5 seconds followed by 3 seconds of a blank screen. Then a 50 x 50 100% contrast box in the centre of the screen for 5 seconds followed by a blank screen.

Note: When Constant is ticked only the highlighted data fields are used

1: Set a delay between the triggering of acquisition and the start of the first stimulus by inputting the “3" seconds in the “Trig” data field. This will provide 3 seconds of acquisition before the presentation of the first stimulus.

2. Tick the “Constant” tick box and the “Bar” tick box in epoch 1.

3. In Epoch 1 set the "Duration” data field to “5” seconds, and the "Width" and "Height”

data fields to “50”.

4. In Epoch 1 set the “Contrast1” data field to “-1” for a -100% contrast box.

5. Next we set the location of the box. In epoch 1 set the “Angle” data field to 0 degrees and set the “Start/Location” data field to 1/2 the screen height. So for a 1280x720 projector half of 720 is 360. This places the centre of our box in the centre of the screen.

6. Next we need 3 seconds of blank screen before the bright box. So in the 1st “ISI” data field put “3” seconds.

7. Then set up the 100% contrast box in epoch 2 by following steps 2-5. But instead of using "-1” in “Contrast1” of epoch 2 use “1” for +100% contrast.

8. To make sure the bright box from epoch 2 disappears after its allotted 5 seconds make sure to put a value in the subsequent “ISI” i.e. the seconds “ISI” data field. Insert “1” for example.

The stimulus panel should now look like this:

You can now run this protocol and check that the squares you have designed actually display as squares!
If not then you need to change the aspect ratio on your display!

Example 2. After 5 seconds of baseline display a box measuring 100 x 300 pixels in the centre of the screen at an angle of 45 degrees for 5 seconds. The contrast of this box will change from -100% to +100% at 3 Hz.

Note: When Flicker is ticked only the highlighted data fields are used

1: Set a delay between the triggering of acquisition and the start of the first stimulus by inputting the “5" seconds in the “Trig” data field. This will provide 5 seconds of acquisition before the presentation of the first stimulus.

2. Tick the “Flicker” tick box and the “Bar” tick box in epoch 1.

3. In Epoch 1 set the "Duration” data field to “5” seconds, and the "Width" and "Height” data fields to “100” and “300".

4. In Epoch 1 set the “Contrast1” data field to “-1” for a -100% contrast box. This sets the first contrast that our box will change to.

5. Now set the “Contrast2” data field to “1”, this is the second contrast that our box will change to i.e. +100%.

6. Now we need to set how quickly the box will change between the two contrasts, Set this in the “Hz” data field. Insert “3” for 3 Hz i.e. the box will change from -100 to +100 3 times per second.

7. Next we set the location of the box. In epoch 1 set the “Angle” data field to “45"

degrees and set the “Start/Location” data field to 1/2 the screen height. So for a 1280x720 projector half of 720 is 360. This places the centre of our box in the centre of the screen angled at 45 degrees.

8. Remember to input a value into the subsequent “ISI” data field to make the stimulus disappear after the specified duration. Note. the reason it doesn’t automatically disappear will become apparent in example 4.

The stimulus panel should now look like this:

Example 3. After 3 seconds of baseline move a bar that is 40 pixels wide and spans the whole screen from one edge of the screen to the other along 90 degrees.

Note: When Motion is ticked only the highlighted data fields are used

1: Set a delay between the triggering of acquisition and the start of the first stimulus by inputting the “3" seconds in the “Trig” data field. This will provide 3 seconds of acquisition before the presentation of the first stimulus.

2. Tick the “Motion” tick box and the “Bar” tick box in epoch 1.

3. In Epoch 1 set the the "Width" and "Height” data fields to “40” and “1500”. When you want a bar to span the whole screen it is useful to to set the height to a number greater than the height of the screen otherwise if you move the bar along a diagonal it may not span the whole screen, Pythagorus theorem etc..
4. In Epoch 1 set the “Contrast1” data field to “-1” for a -100% contrast box.

5. Now we need to decide where the bar stimuli will start. As the “Start/Location” data field defines where the **centre** of the bar will appear, inserting a “0” in this field when the bar width is 40 will result in the box initially appearing half off the screen, i.e. with only 20 pixels of its width on the screen. You can make the leading edge of your bar start at the very edge of the screen by inserting “-20” or (- half the bar width) in “Start/Location “.

6. Now we define where the bar will stop. Just like in point 5 the data field “Stop” defines where the **centre** of your bar will stop. To make the bar traverse the whole screen and then completely exit the screen insert “740”

7. The angle along which the bar will move is defined in the “Angle” data field set this to “90” degrees.

8. Now we will set how fast the bar moves. The “Speed” data field describes how many

pixels per screen refresh the bar moves. The screen refresh of your screen is calculated upon starting shapeshifter and is displayed under “Start”. Therefore a value of “3” in the speed data field will move the bar 3 pixels every time the screen refreshes which is 60 times per second, so the bar will move 3*60=180 pixels per second.
8. Remember to input a value into the subsequent “ISI” data field to clear any previous stimuli on the screen. . Note. the reason it doesn’t automatically disappear will become apparent in example 4.

Your finished protocol should look like this:

Example 4. After 3 seconds of baseline move a bar that is 40 pixels wide and spans the whole screen from one edge along the angle of 90 degrees and make it reverse its direction of travel at the centre of the screen.

1: Follow points 1-5 from Example 3.

2. We want the bar to reverse in the middle of the screen, so first of all it has to stop there. Set the “Stop” data field of epoch 1 to “360”. So for epoch 1 the bar moves from the edge of the screen to the middle.

3. Make sure the first “ISI” data field is “0”, when an ISI data field is 0 the previous stimulus is NOT cleared from the screen. Normally you ant you stimulus to disappear, but in this case we don’t so we insert a “0".

4. Set up the bar width height contrast and speed in epoch 2 to be the same as for epoch

1.

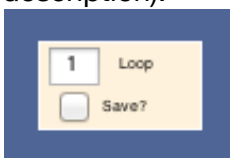
5. After reaching the centre of the screen we want our bar to move in the opposite direction, so insert “270” degrees into the “Angle” data field of epoch 2.

6. Our bar has reached the centre of the screen going in one direction now we specify where it moves from and to in the opposite direction. So the “Start/Location” in epoch 2 is the centre of the screen so insert “360” for this data field. We then want it to move off the screen so in the “Stop” data field insert “740” for it to complete move off the screen.

7. Remember to input a value into the subsequent “ISI” data field to clear any previous stimuli on the screen.

Your finished protocol should look like this:

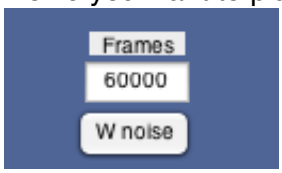
Using loop to repeat sequences
You may want to repeat the whole stimulus sequence several times in a row, insert the number of presentations you want in the “loop” data field. If you only want to do one presentation insert a 1.
Remember you can save your protocol by ticking the “save’ tick box (see button description).



Receptive field mapping

White noise
White noise will load a play a pre-prepared movie that should contain a checkerboard stimulus. This is used to map the spatio-temporal receptive fields (RFs) of visual neurons. The checkerboard movie should be called “m.mat” and be placed in the current directory of Matlab. The first time you install Shapeshifter on your computer you will need give shapeshifter the full path to this file. Open the "shapeshifter.m” file scroll to line 2742 and change the value of the string inside the import to the variable “mov” to the full path.

You can specify in the frames data field you can specify how many of the frames of this movie you want to play.



FBP
To map RF using a series of flashed bars use the panel with the "RF Map” button. Details of how this method works can be found in (http://www.ncbi.nlm.nih.gov/pubmed/25172952) and the code for analysis can be downloaded from (http://www.igorexchange.com/project/FBP).

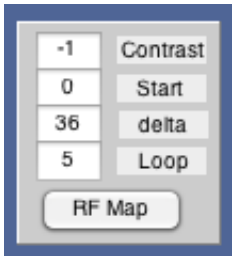
You will need to define a sequence for the flashed bars, this should be in a matlab file called “RFsequence.mat” and located in the current Matlab directory.The first time you install Shapeshifter on your computer you will need give shapeshifter the full path to this file. Open the "shapeshifter.m” file scroll to line 2846and change the value of the string inside the import to the variable “random” to the full path.
Note: Designe your RF sequence carefully.

Set the contrast of your bar in the "contrast" data field. The angle at which the first presentation of your RF sequence will be presented is defined in the “Start” data field. If you only want to present bars along one angle leave the “delta” at 0 and set “Loop” to 1.

If you want to map the whole spatial and temporal RF you need to present you sequence of bars at five or more angles. To set this up:

1. Set the “contrast” to "-"1 for a -100% bar.
2. Set the “Start" angle to "0"
3. Set the change in angle “delta” to “36" degrees
4. Set the “loop” to “5” so that the protocol will display the sequence 5 times.

Press the RF Map button to run the protocol.


-1
Contrast
0
Start
36
delta
5
Loop
RF Map