Marjorie Xie

Visual Stimulus Notes

Last update: 08/03/16

playstim.m: Accepts three inputs from the user: stimulus function name (e.g. ‘samplestim1’ - assumed to be written by user, saved in the correct folder, and added to path), stimulus duration (sec), start signal. Runs the stimulus function specified by user, passing in the necessary parameters. Borrowed from Helen: initialization of NIDAQ and Psychtoolbox (initPyschTbx.m), plotting of the voltage readout of the photodiode.

Questions

1. LightCrafter Control settings
   1. Would we need to reset these each time we restart the LightCrafter? How do you save settings? Would the settings change depending on the stimulus we want to present?

There’s an option to save a solution in the LightCrafter software. It’s a button in the middle of the window labeled ‘Save Solution’ and then you should be able to load the saved solution with ‘Apply Solution’. I haven’t tried it, but it should allow the settings to be reloaded each we restart the LightCrafter.

I could see a standard set of settings for most stimuli, but in special cases, the user may want to change them (e.g. to try to get a faster frame rate or a greater bit depth). I think we should go with 3 patterns of equal length that fill the pattern period and use the RGB channels all to drive the blue LED, as that would allow stimulus to be presented at 3X the nominal refresh rate of the LightCrafter. If that kind of stimulus presentation rate is not necessary, the 3 channels could be driven in the same way.

* 1. Why are we using a bit depth of 6? Why not 8?

The LightCrafter has a set of bit depths and pattern exposure periods that are available (see Table 4-1 on pg. 49 of the manual). With 8 bit, the mininmum pattern exposure is 8.333 ms, which maximizes the stimulus presentation rate at 120 Hz (1 pattern with that exposure and period). If we instead drop the bit depth to 6, we could present 3 patterns in that time (and use the different RGB channels to make them different) for a much higher stimulus presentation rate.

Like we talked about before I left, I was having trouble making the LightCrafter present correctly with a refresh rate of 100 Hz and was instead using 80 Hz. I don’t know if you solved that problem, but if we use an 80 Hz refresh rate, we could get a 240 Hz stimulus presentation rate with 6 bits and 3 patterns, which I think will be the best for our purposes. It makes the stimulus writing a tad harder, but I think it would be the best approach.

1. Stimulus
   1. black = BlackIndex(screenNumber); Does not give me pitch black. When I display blue light, “black” is really just low luminance, which is nonetheless still blue!

Is black = 0? That is as dark as it will go, regardless of what the BlackIndex function returns. Projectors, including the LightCrafter and the DLP, don’t normally go to pitch black; the light is always a little bit on. Theoretically, you could cut the current to the blue LED and that would make true black, but that’s not how the LightCrafter modulates luminance, and I don’t believe you could do that during a stimulus. The little bit of light that’s left will be something we have to measure and take into account when calculating stimulus contrast.

* 1. What is the wavelength of the blue light from the lightcrafter and how does it compare to the blue we were using from the DLP? Does it matter if we will be using a visual stimulus filter?

I don’t know what the wavelength is, but because it is an LED, it is actually spans a decent range of wavelengths (LED spectral distributions have long tails). We can measure it with a spectrophotometer that we have, and we definitely should. I’ll show you when we’re both back. Then we’ll compare it to that from the DLP. We will be using the same 482/18 nm filter, but the wavelenght profile probably won’t be the same because I doubt the LED and the DLP have the same underlying wavelength distribution in that range. The visual stimulus filter is necessary because of the long tails of the LED distribution. We’ll get bleedthrough of the visual stimulus otherwise.

1. Psychtoolbox
   1. Ifi = “vertical refresh rate of the monitor” – vertical as opposed to what?

This is a legacy from when the standard monitors used (especially for the psychophysical experiments that Psychtoolbox was designed for) were CRT monitors. These scanned a beam across the screen from top to bottom to display the image, so the vertical refresh rate is frame rate of the monitor. It’s as opposed to the horizontal scan rate.

* 1. Using KbCheck, the stimulus doesn’t stop when I hit ESC. Is this because we’ve set Psychtoolbox code to MaxPriority so it might not listen for keyboard presses?

MaxPriority shouldn’t interfere with KbCheck. When the stimulus wasn’t stopping, were you using a 1 or 2 second fff? With how you have the stimulus written, a new image is only flipped to the screen every 1 or 2 seconds and the code will be on the Screen(‘Flip’) line until the flipping happens. Therefore, the loop isn’t calling KbCheck very often.

An alternative is to flip at the refresh rate of the LightCrafter, but to present the same image when it is flipped. This is more demanding of the computer’s resources, though honestly, that better still work since there will be stimuli (e.g. white noise) where we’ll need it to do that.

Building blocks of an image

Images can be presented up to a frame rate of 120Hz. A single video frame is composed of 3 color channels RGB. Each color gets a time slot within that frame of 120Hz/3 = 2.78ms. Each color time slot is partitioned into 8 bit-planes (e.g. G0-G7). This all means that a single video frame is a series of bit-planes presented in sequence. The number of bit-planes you use determines the maximum presentation rate. If you use all 8 bit-planes the minimum pattern exposure period is 8.333ms or 120Hz. If you use 6 bit-planes, minimum pattern exposure period is 2.5ms. The current monitor refresh rate is 100Hz. This means that each frame is 10000us (10ms). If we are using all three sets of bit-planes to present 3 patterns, we In terms of hardware, each bit in a bit-plane gets a set of mirrors in on/off mode. The intensity of the color is controlled by the amount of time mirror is on.

Pattern exposure and period set the amount of time a pattern is presented and the amount of time between patterns. So if you set exposure = period = 5000 (5ms per pattern), you barely see any flicker. But if you set exposure = period = 10000 (10ms per pattern), you see flickering between frames.

Hardware Caution

“The DLP LightCrafter 4500 is an actively cooled system that has a thermal limit resulting in total simultaneous red, green, and blue LED currents less than 4.3 A for continuous LED operation. Do not overheat the system by turning all LEDs at maximum power during prolonged and simultaneous LED use. **Exceeding more than 4.3 A** for continuous or simultaneous LED operation can **damage the LightCrafter** 4500 LEDs.”