1.) Changing ROI

This can be done in **three ways**. First, you can **choose a preset ROI** from a dropdown menu on the "ROI Selection" part of the front panel. The preset ROIs include the *full field of view*, the *central quadrant*, and the *red laser spot*. When you select a new ROI from the dropdown menu, you must click UPDATE ROI in order for the change to take affect. Secondly, in this dropdown menu there is an option, *custom ROI*, which then allows you to **type a custom ROI** into the text fields below, specifying xoffset, yoffset, xwidth, and ywidth. Lastly, you can **draw an ROI** by clicking the DRAW ROI button. When you click this button, four lines will appear on the outside of the image viewer (they should be red and yellow in color). You can then grab these lines and drag them across the displayed image to form a box. Clicking UPDATE will make the box formed by the cursors the new ROI.

NOTE: In "DRAW ROI" mode, If SYMMETRIC is selected, symmetry of the box is enforced across the center line of the camera, optimizing the speed at which the camera is running. There is an indicator entitled *Max Camera Rate* that will update after you select a symmetric ROI and tell you the frame rate at which the camera can run on the current ROI.

2.) Image Registration

There are two buttons on the front panel entitled PREPARE and GO!. Clicking PREPARE will load a preset image registration image onto the DMD and display it onto the sample. Focus the camera, then click GO!. A Matlab image window will pop up. Use the cross hairs of the cursor to click on the points of intersection between the boxes; these are the specified control points. Double-click on the last of the three selected points, then double click again to finish clicky. If you accidentally select more than two polygons or more than three points due to double-clicking struggles, it should still work. A window will pop up to let you know when image registration is complete.

NOTE: this step produces a text file at a location specified on the third tab of the program. If you haven't changed the alignment at all, there is no need to do registration again as the transformation matrix will automatically be loaded from this text file. I suggest that no one change this path, as the setup should only have one transformation associated with it at any point in time.

3.) Making and Loading a DMD image

There are three options for loading images onto the DMD. First, you can create your own movie by doing "clicky." This "movie" (really just a single frame) will be stored as a binary image at the location specified by *Clicky Movie Path.* To create this movie you must first click DEFINE OBJECTS. This will pop up a Matlab image viewing window containing the current image. You can then draw polygons with the cursor, double-clicking to complete each polygon and double-clicking at the end to finish drawing polygons. These objects are stored in the internal memory of the program. When you click, MAKE MOVIE, a binary movie file is written to the *Clicky Movie Path* with the DMD image that will illuminate the specified regions of the sample. (NOTE: These "movies" are only FRAMES/IMAGES! they will not change dynamically in time.)

Use the toggle switch to select whether you want to play the *User Specified Movie* or the *Clicky Specified Movie.* When you click PLAY MOVIE, the DMD will grab the image from whichever of these paths has been selected with the toggle switch and display it on the sample.

Lastly, there is a button labelled ALL ON which will fill the whole DMD illumination spot with blue light.

4.) Snapping a Picture

To simply take a picture, click SNAP AND SAVE. This will save a picture in the specified base path with the specified file name, appending to the file name a time stamp. The images will save as tiffs, and there will be a text file saved with the same name that contains experimental parameters.

5.) Taking a movie

INTERNAL TRIGGER: Simply select the number of frames and the exposure time. When you click ACQUIRE DATA, the specified number of frames will be recorded at the given exposure time and saved to a binary file

with the given name in the given directory. You will know this process is complete when the*status* bar says "READY".

EXTERNAL TRIGGER: Toggle to external trigger, type in the number of frames that will be recorded in external trigger mode. From my experience with Daniel's program, this will be one less than the number of frames listed on his front panel. Then, click ACQUIRE DATA. This will put the camera in external trigger mode, and it will wait to record frames until triggered from an external Labview program. Make sure that the external program does not try to trigger the camera faster than the *Max frame rate.* (NOTE: whatever the program says is the exposure time, this is disregarded in external trigger mode, as the "exposure" is specified by the generated triggers).

6.) Reading the Binary Movie into Matlab

To read in the binary movie and the header information, follow this example, where path is the full path and filename, lacking the .txt or .bin designation:

```
path = 'C:\data\2013-11-23_patterned_cardiomyocytes\binary_read_test_at110745';

% read binary file
A = importdata([path,'.txt']);
B = A.data;
dt = B(1)/1000;     % exposure time
nframe = B(2);
ncol = B(6);
nrow = B(7);
M = readBinMov([path,'.bin'],nrow,ncol);
```

7.) Toggling the red and blue lasers

CAUTION: Do not try to toggle the red and blue lasers from both this program and an external program at the same time! Calling the DAQ card from two different labview programs will cause an error.

8.) Trouble-Shooting

The *Initialization* tab and the *DMD control* tab contain error messages to help you if anything appears to not be working. The biggest issue I've had during development is that sometimes the DMD will stop communicating with the Labview program. This has not happened in my latest round of testing, but if there is some corner case that I have missed, you will have to restart the computer in order to get Labview and the DMD talking again (the exception to this is if the ALP software is running, closing the software will fix the problem). For all other issues, power cycling the hardware and/or restarting the Labview program should be sufficient.