**Processing for stereo**

**Dependencies:**

* ffmpeg and ffprobe: <https://ffmpeg.org/download.html>
  + Put ffmpeg and ffprobe somewhere convenient (programs folder?)
  + Make sure path to binaries is in your $PATH$ environmental variable
* Shotcut: <https://shotcut.org/download/>
* MATLAB (recommend 2020a or newer)
  + Make sure you have the Computer Vision toolbox
* GitHub Desktop (or just command line git if you prefer): <https://desktop.github.com/>
* Then use git to clone these repos and add them to your MATLAB search path:
  + <https://github.com/treelinemike/stereoFrameExtract.git>
  + <https://github.com/treelinemike/surgnav-tools.git>

**Connecting drives to computer**

* Cards only go in 1 way
* Find drives
* Make sure everything labeled appropriately on hard drives
  + Label as something intuitive
  + Use L and R in names

**Synchronizing L/R videos in time, and identifying frame pairs for processing (either calibration or reconstruction)**

* Start Shotcut (will use to visually align L & R videos in time, and to select pairs of frames to extract for further processing)
* In playlist tab, drag in L&R calibration (checkerboard) videos
* Drag to timeline L first
* R click below and click add video track
* Add R channel
* Drag both tracks to start at time zero
* Click on Right video in timeline. Then click filters tab, +, video filter, size position and rotate
  + Use 900 for first dimension of size
  + Make position 1000
* Click on Left channel
  + Apply size and position filter again, this time with size 900 but position 0
* Add another filter TO LEFT CHANNEL
  + Go to Video, Text simple
  + Delete time code and hit frame number button
  + Change size/font as necessary so you see frame number below the video channels
* Go back to the beginning and step through with arrows to find lights
* Find a place where it transitions, you’ll probably find the two channels aren’t synchronized
* Find one frame where clear what’s happening (one frame forward vs back big transition)
* If light transition event happens sooner in the Left channel:
  + Figure out how many frames (this case 3)
  + Move playhead to frame 3
  + Zoom in on timeline
  + MAKE SURE RIGHT (not left) CHANNEL IS SELECTED
  + Click split at playhead
  + Delete portion of R video before the playhead (3 frames long)
  + Click and drag remaining R channel video back to beginning
  + Check frames to confirm that light transition is now synchronized
  + YOU WILL ENTER 3 (positive) as the offset in the runFrameExtraction.m file
* If light transition event happens sooner in the Right channel:
  + Figure out how many frames (this case 3)
  + Move the playhead to frame 3
  + Drag the right channel to start at the playhead
  + YOU WILL ENTER -3 (negative) as the offset in the runFrameExtraction.m file
* Figure out the frame number of the pairs you want to extract for calibration or reconstruction
* Open excel (only write numbers)
* First two frames are the frames on either side of the transition point (our case 384, 385)
* Go through frames looking for a good checkerboard
  + Want frames with whole checkerboard, minimal glare
* Save frame numbers into excel sheet (want 30 pairs)
* Save excel as .csv in folder for today
* Need file ‘runframeExtraction.m’
  + You’ll have one for each run
* In Shotcut, save project
* Click properties (the I in the top)
  + Need the Frame Rate (29.97 in our case)
  + Shotcut is flaky; may need to restart and/or click on the L or R channel when you hit properties

**Using MATLAB & ffmpeg to extract the frame pairs you identified above**

* Open MATLAB
* If this is the first time you’re using this code add Mike’s cloned repositories to path (stereoFrameExtract and surgnav-tools)
* Go to your project working folder in matlab
* Open runFrameExtraction.m
* Put in the L and R video files
  + Have to figure out where the files are (on the external drives)
  + Path to Left video file first, then path to Right video file
* Offset (+/- number of frames, see above)
* Path to CSV file with frame numbers to extract
* Frame rate as identified in Shotcut (will be 29.97 for the da Vinci S)
* Run runFrameExtraction.m
* Check first two images on each side of transition to make sure you get what you expect

**Running Stereo Calibration in MATLAB**

* Move or delete any non-checkerboard images from the L and R folders (e.g. the frames you extracted on either side of the light transition to verify time synchronization)
* Make sure you have the Computer Vision toolbox for MATLAB
* In command window type steroCameraCalibrator and enter
* Click the Add Images button
* Select folder of L images for camera 1
* Select folder of R images for camera 2
* 6 mm grid if using Mike’s calibration plate
* Click OK
* Check the skew and tangential distortion boxes (computes those parameters as part of calibration)
* Hit calibrate
* Delete all pairs with errors over 1 pixel (start with highest error and work down)
* Export Camera Parameters
* Export to workspace
* Check export estimation errors
* In workspace “svster” and enter (saves stereo calibration as mat files… this is a routine in one of Mike’s repositories)

**Read MATLAB info on stereoreconstruction**