SOP: 2D Video Digitizing Using DLTdv5

A. What this SOP covers

If you have a single video view of something moving and you want to digitize points on the moving object, use this SOP. Because there is a single view/single video, you can only track movement of a point on a plane, so in 2D space. For 3D motion tracking, you need two or more videos or a single video with two views. This SOP assumes that you start with a video taken of something moving, and will allow you to produce a comma-delimited file that includes x, y coordinates for one or more points. The coordinates will be in pixels, and so if you plan on converting pixels to distance (like centimeters), you need to have a scale object in the video.

B. What you need before you start

- Your video in an appropriate AVI format
- MatLab software
- The DLTdv5.m file, which is a free script written for MatLab by Ty Hedrick (http://www.unc.edu/~thedrick/)

C. Procedure

1. Running DLTdv5
   a. Run the Matlab program, by clicking on the desktop shortcut or using the start menu.
   b. In the left-hand navigation pane of MatLab right-click on "DLTdv5.m".
   c. Select "Run" from the menu that pops up.
   d. A window will appear with "DLTdv5 controls" written at the top.

2. Opening a video using DLTdv5
   a. In the DLTdv5 control window, click on the "Initialize" button.
   b. Select "1" video in the dialog box that appears and click "OK".
   c. Navigate to your video suing the dialog box that appears and click "Open".
   d. A window will appear with the first frame of the video.
   e. Drag the boundaries of the video window to enlarge it to the desired size. Making it bigger is necessary to minimize digitizing error, but if you make it too big, the image will be too pixilated and difficult to see detail.

3. Basic video navigation controls in DLTdv5
   - You will need to move the video forward and backward frame-by-frame and maybe zoom in and out. Make sure that the window with the video in it is active, otherwise nothing will happen. Here's how you do it:
   a. Forward: Press "f".
   b. Backward: Press "b".
   c. Zoom in: Press "=".
   d. Zoom out: Press "-".

4. Getting ready to digitize the video
   a. You can adjust the gamma of the video, which can adjust the contrast of the points you are digitizing relative to the animal/background.
   b. You can display the video in color. Black & white works better because contrast is higher.
   c. You can use the slider bar to advance the video to the desired frame.
   d. Start by clicking on the "Add a point" button until all of the points that you wish to digitize are added.
   e. When digitizing ensure that the correct point number is assigned to each point as follows:
      Point 1: Occiput of the head
      Point 2: Mid-dorsal at the pectoral girdle
      Point 3: Mid-dorsal, and half way between points 2 and 4
      Point 4: Mid-dorsal, at the pelvic girdle
      Point 5: Mid-dorsal at the level of the cloaca
      Point 6: Right knee (the animal's right, not yours)
      Point 7: Left knee
      Point 8: Right elbow
      Point 9: Left elbow
      - If you are digitizing a subset of points, then move the points up (don't leave black points), and make a note of this in your notebook. If you need to digitize additional points or different points, then make a note of this in your notebook. Also note this in a text file or Word document in the folder with your data and spreadsheet.

5. Video digitizing
   a. From the "Current point" drop down menu, select the point number that you want to digitize. Digitize points completely one at a time.
   b. From the "Autotrack mode" drop down menu, select "automatic".
   c. Click on the desired point in the video. The computer will automatically play through frames of the video, digitizing each as it goes.
   d. When the computer cannot digitize the point in a frame, it will stop. Click on the point again, to help the computer with the uncertain frame and it will resume.
   e. Repeat step 5.d. until the point moves off the edge of the video.
   f. Move on to the next point by repeating steps 5.a. to 5.e. The active point will appear in red, while the other points will appear in green. Make sure that you are clicking on the correct point, the one that corresponds to the number you are on.
   g. Digitize all of the points that you need.

6. Proofreading digitized points
   - Once a point is digitized, if you play through the video, you will notice that in some frames, the circle demarcating the point jumps slightly. This is a digitizing error that can invalidate future calculations. Points should move smoothly with no jumping from frame to frame. Proofreading corrects these small, yet significant, errors.
   a. Select the point you wish to proofread from the "Current point" drop down menu.
   b. Switch the "Autotrack mode" to "off.
   c. Activate the window with the video.
   d. Use the "f" and "b" keys to detect errors. Playing through frames reasonably quickly allows you to see errors more clearly.

e. When you detect an error, re-click on the point in that frame to correct it.
f. Also, notice that there is a small pixilated graphic of the point in red crosshairs in the bottom right corner of the DLTdv5 controls. This is a close up of your point. Ensure that when you correct the point, the cross hairs are in the middle of the digitized point.
g. After completing one pass of proofreading and correcting, take a second pass to ensure that there are no digitizing errors. Repeat until the digitizing is free of errors.

7. Saving your digitization data
- Once you are done digitizing the points in a video, you need to save the coordinates.
a. Click the "Save Data" button at the top of the DLTdv5 controls.
b. Select a folder to save the data in and click the "OK" button.
c. In the "Data file prefix" dialog box, replace the text right above the buttons at the bottom with the prefix you want used to save the files. Your prefix should specify what the video is of, follow our lab's procedures. For example, in "Bv12_T_L_03_", Bv is the species identifier, 12 is the specimen number, T and L describe the trial type (in this case, T would mean the tail is intact and L would mean that the animal is running on level ground), and 03 is the trial number.
d. Click "OK".
- Note that four files are produced. Since you are digitizing 2D and not 3D video, the files ending in "offsets", "xyzpts", and "xyzres" are empty. The file ending in "xypts" has your data. Do not delete any of the files.

8. Loading digitization data
- In some cases, you may not have time to completely digitize and proofread all of the points in a video in one session. In these cases, you will need to save your partial data (follow step 7), and then load it to continue.
a. Follow steps 1 and 2 to run Matlab and open your video.
b. Click the "Load Data" button in the DLTdv5 controls.
c. Select the file ending with "xypts" and click the "Open" button.
d. Click "OK" if you get a warning message (it pertains only to 3D digitization).
e. Continue digitizing and proofreading (Steps 3 to 8).