

Alex's Recipe for DeepLabCut

For additional instructions visit the DeepLabCut User Guide:

https://deeplabcut.github.io/DeepLabCut/docs/standardDeepLabCut_UserGuide.html

1) Open Anaconda Prompt

2) Use the following commands in the Anaconda Prompt:

a) `conda activate DEEPLABCUT`

b) `ipython`

c) `import deeplabcut`

d) `deeplabcut.launch_dlc()`

3) GUI should open and you can either create a new project or load a previously started project.

4A) STARTING NEW PROJECT (or see 4C to Load Project)

Choose a relatively short name without spaces and no capitalization this helps to keep DLC from becoming confused. Fill out the rest of the info including picking videos and have them copied to the new location.

4B) You can then go to the config file and edit the body parts and other parameters you may want to change from the default conditions prior to continuing. If you are editing on a new device, you will need to change or update the Project Path (line 9) to the correct location on that device. Use appropriate names for bodyparts, and the skeleton section should connect all points using format:

`[[bp1, bp2], [bp2, bp3]...]`. You will need to reload the project or at least the config file before continuing.

4C) LOADING A PROJECT (skip if starting a new project)

By choosing to load a pre-existing project you can navigate to the appropriate config file for the project you want to continue working on and select that to load. Then you can skip ahead to the step you are interested in continuing from.

5) EXTRACT FRAMES (move thru GUI tabs left to right)

Here you will select frames from the video(s) you want using automatic or manual extraction of frames. Just hit Quit once you've 'Grabbed' the frames you want (if manually extracting).

6) LABEL FRAMES

After extracting a range of representative frames you can then label the selected frames by navigating to the appropriate videos you have extracted frames from in the pop-up folder. Save after each frame in case GUI crashes. Hit Quit when done with specific video. To label more another video select the option to label another dataset when prompted after pressing 'Quit'.

7) CREATE TRAINING DATASET

Now create your training dataset by choosing your network (resnet_50 works well, though it's all I've tried so far). Can leave everything else as default and press 'Ok'. Can check that it was created in Anaconda Prompt.

8) TRAIN NETWORK

Probably want to start with the default settings and tweak if needed. Once you hit 'Ok' you can navigate back to the Anaconda Prompt and check that the training is indeed starting. This will likely take several hours so make sure the computer will not fall asleep on you.

If set to default the Anaconda Prompt display will be updated after every 1000 iterations, what you're looking for is the model to achieve a minimum loss value (mine generally gets to 0.0004). You don't have to continue training to the maximum iterations if you converge on the minimum well before the max iteration. You can stop training by pressing 'Ctrl c' in the Anaconda prompt. Also pressing the space bar to wake up the computer while the screen is off pauses training, so it is recommended to open up another window or application so that DLC runs in the background in case you hit the space bar.

9) EVALUATE NETWORK

You can evaluate the network after training it by the next tab. Follow the output in the Anaconda Prompt to determine where to look for your evaluation(s) and update the config file if necessary.

10) ANALYZE VIDEOS

You may skip over Video Editor if you do not need to edit your videos. When analyzing videos select the videos from your folder and select the appropriate attributes you want. If you want a csv of the pixel coordinates select 'Yes', you likely want to filter the predictions as well. Then click 'Analyze Videos' and it should show the progress in the Anaconda Prompt.

11) CREATE VIDEOS

If you want to create labeled videos use this tab to select the videos you want to create with labels and specify the attributes you want in the video and then select 'RUN'. Your labeled videos will be saved in the video folder with the corresponding training specs in the filename.

12) EXTRACT OUTLIER FRAMES

If after training the network the videos look like the labeling is off, you can extract outlier frames to (re)label and then retrain the model. Select the video(s) you want to extract outliers from and specify the algorithm - jump is for when the pixel location jumps significantly and manual allows you to scroll through the video and 'grab' individual frames you want to extract. Once you've extracted frames from each video that you want to extract outliers (one at a time) you can then move on to Refine Labels.

13) REFINE LABELS

After Extracting all the frames from each video and relabeling them 'Launch' the program and load in the appropriate frames you just extracted to relabel them. This is where you can move labels or delete them using the backspace key. After doing this for each individual video you extracted frames from you can then 'Merge Dataset'. Then you can go back to the TRAIN NETWORK tab (step 8) and retrain.

14) GET 3D KINEMATICS

You will need to create and save four DLTdv files with the xypts from the DeepLabCut outputs, the MATLAB script 'DLC_to_DLTdv_Converter.m' can generate these files for you. You can then open the DLTdv8 app and load in the appropriate video(s) and calibration file and load in the *xypts.csv points you just saved. For 3D analyses, navigate to 3D > Recompute 3D points to recalculate the xyz points from the xypts of the individual camera views. You can also fix any outlier frames/points with the DLTdv software. Now export the newly computed 3D points by going to Points > Export and saving to the appropriate location.

For help with DLTdv software visit Ty Hedrick's website: <https://biomech.web.unc.edu/dltdv/>