**3D calibration and projection**

There are six scripts involved in the pipeline starting with calibrating and ending in figure generation.

The six scripts are listed below:

**1-Calibration.py**

**2-NPZ-avi\_conversion.py**

**3a-label\_images\_separate\_models.py**

**3b-label\_images.py**

**4-Map\_to\_3D.py**

**5-Figure\_generation.py**

**1-Calibration.py**

To begin the calibration process, you need to take several images of an object with a known 3D location that you define. Read the tips in the script for advice on doing so.

**2-NPZ-avi\_conversion.py**

Here we convert the npz files generated from the last script into a video, and folder containing images from each frame. The video will not be used but can be viewed to make sure everything is generally correct. It is a good idea to step through your images and make sure the object you’re labelling can be seen in every image. If it’s obstructed in some, note the image number and camera.

**3a-label\_images\_separate\_models.py**

If you are going to build separate models for your front and back paws, use this script, otherwise, use the next script (3b). As of now, the determining factor of whether you should use 3a or 3b is whether or not we have solved the issue of using NaN’s for data when the body part cannot be seen. Currently this is unsolved.

This script enables you to show each picture that you took during calibration and label the x and y coordinates of your object in its known 3D coordinates by clicking on it. Choose a point that can be viewed by all the cameras in your model – I chose the tip of the eyeblink prop.

You will need to specify the camera numbers you’d like to use for each model you build, the image numbers you’d like to start and end with, and the image numbers for any obstructed images within that [start, end] interval.

After labeling your images, the real coordinates will be read in and added to the end of your data. The modeling script (4) will then use your labeled coordinates to predict the real coordinates.

**3b-label\_images.py**

If we have solved the issue with obstructed points, and we want to use every camera in the setup to build our model, use this script. Here, when the object you’re labeling is obstructed, click the top left corner within 10 pixels of the x and y axis. This will fill in that point with ‘NaN.’

**4-Map\_to\_3D.py**

In this script, we build our models that map our labeled points to their real world coordinates, standardize the DeepLabCut data we’d like to project into 3D, and then create a csv with the 3D predictions of every body part in our DLC data.

See comments in script for help.

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**5-Figure\_generation.py**

This script contains the data processing and code to generate plots we thought might be interesting to visualize. Also includes the code to generate the rotating video we have of the paws moving during walking.

Plots are labeled