

DeepLabCut

markerless pose estimation of user defined features



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December 2018
DeepLabCut Workshop - Warsaw



Who are you?

- Did you install DLC?
- Have you used DLC?
- What pose-estimation/behavioral analysis problems are you interested in?

How does it work?



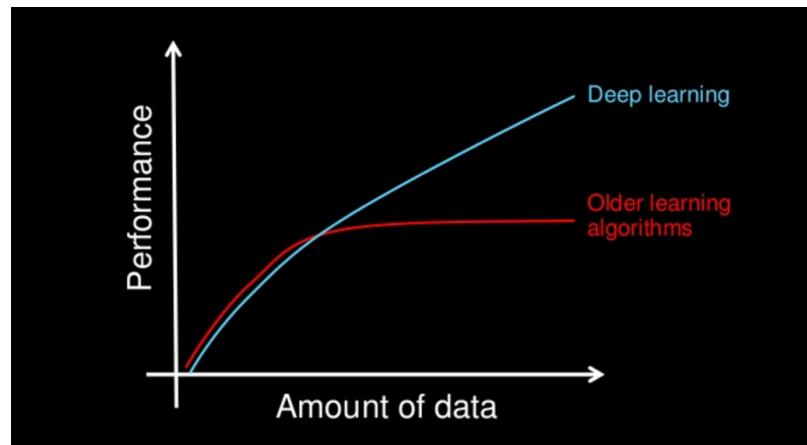
DeepPose
DeeperCut
OpenPose
Conv. PoseMachines
...

Deep neural net
(hierarchical visual representation)

image → Predictor → pose

train Labeled images

A lot of labeled images!

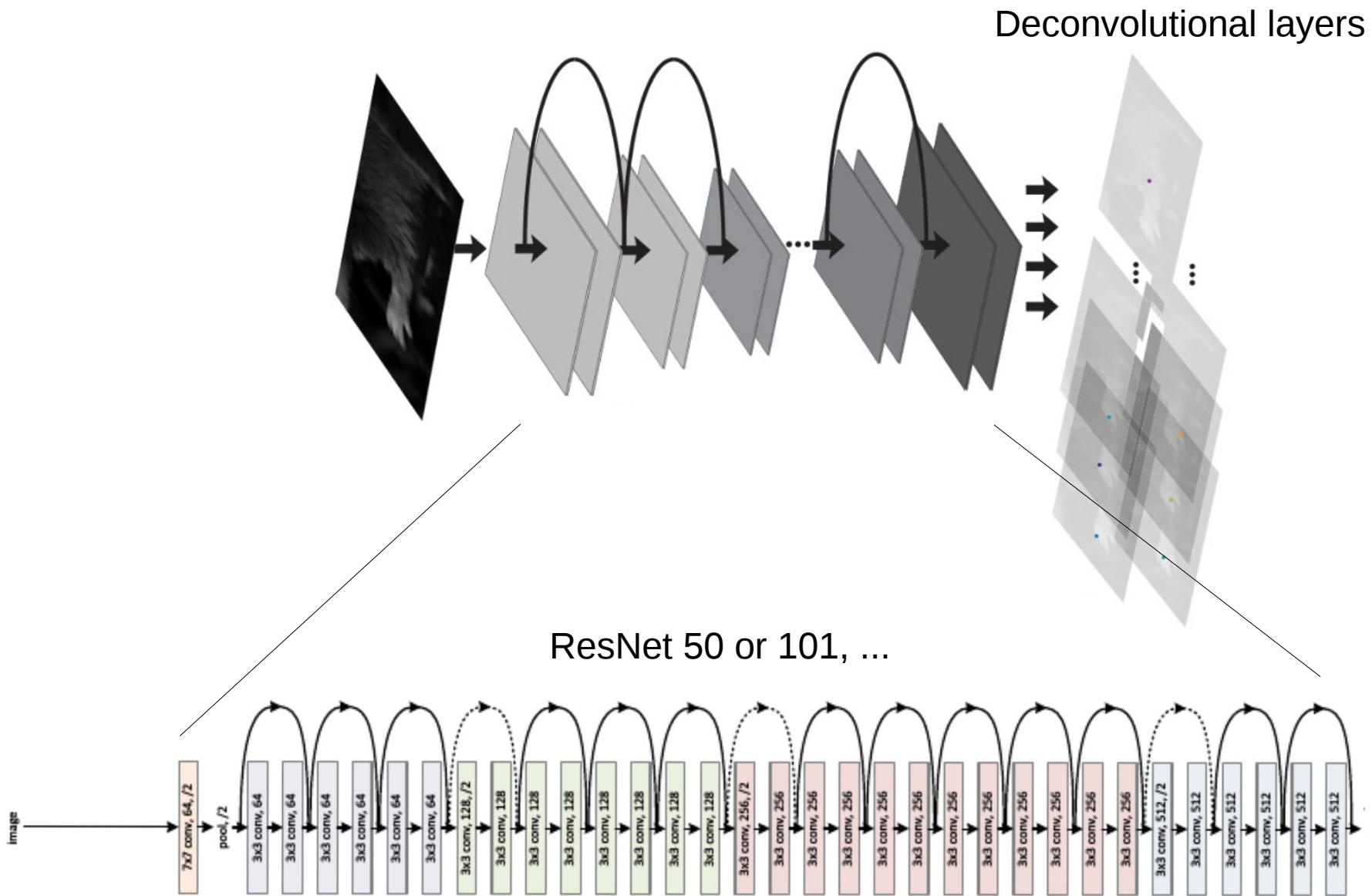


Andrew Ng

Deeper Cut

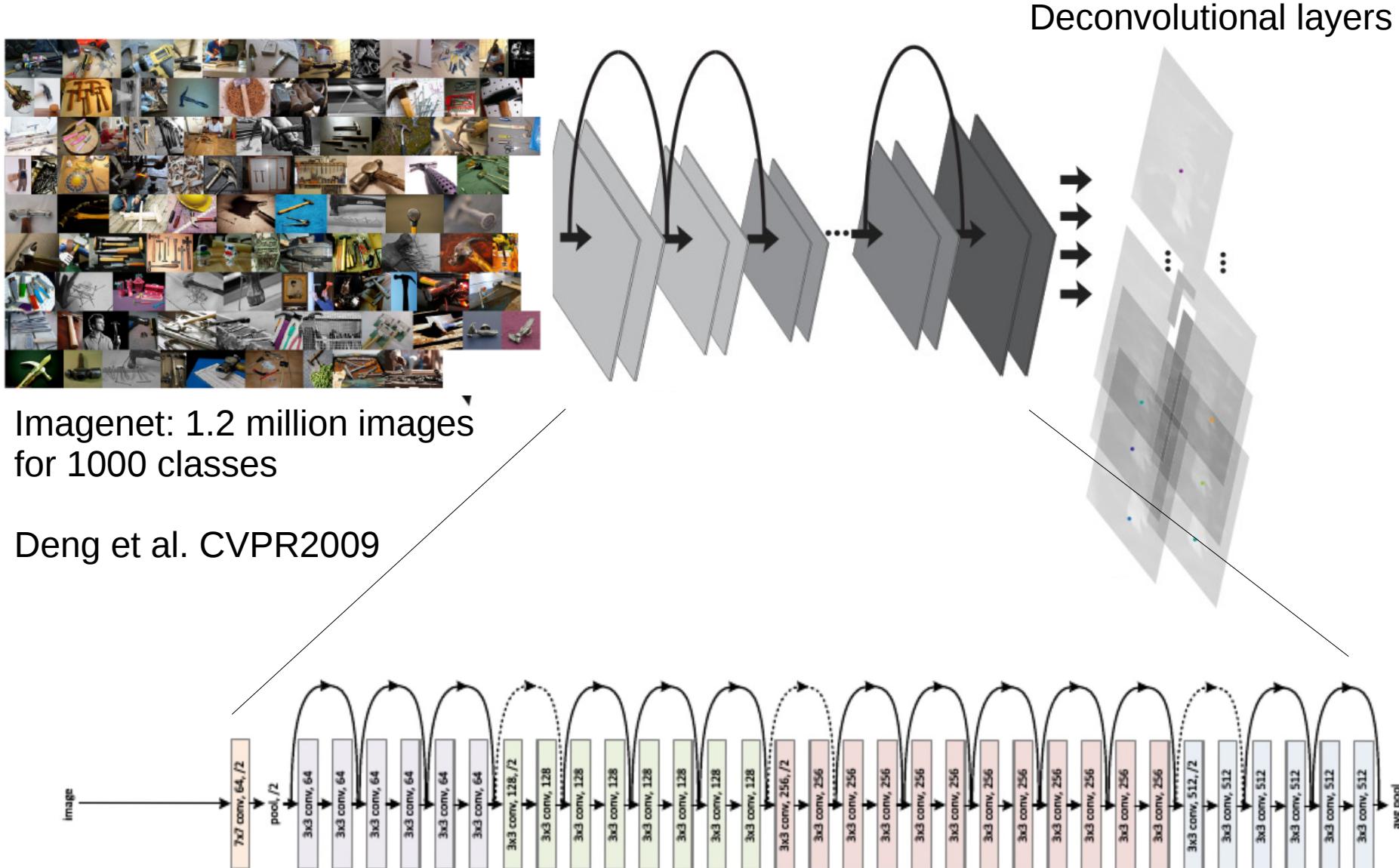


DeepLabCut - the algorithm



Problem: $> 10^7$ parameters! (filter weights etc.)

DeepLabCut - the algorithm

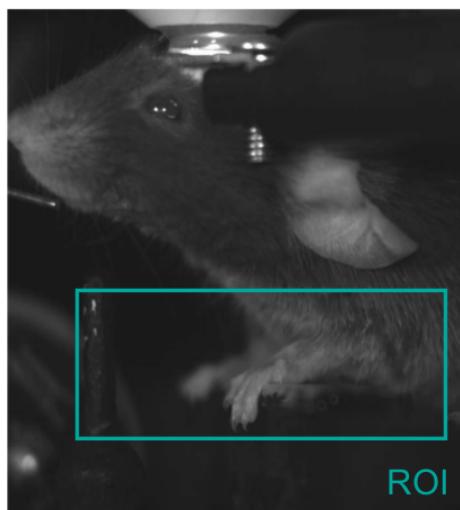


End-to-end training

DeepLabCut Toolbox

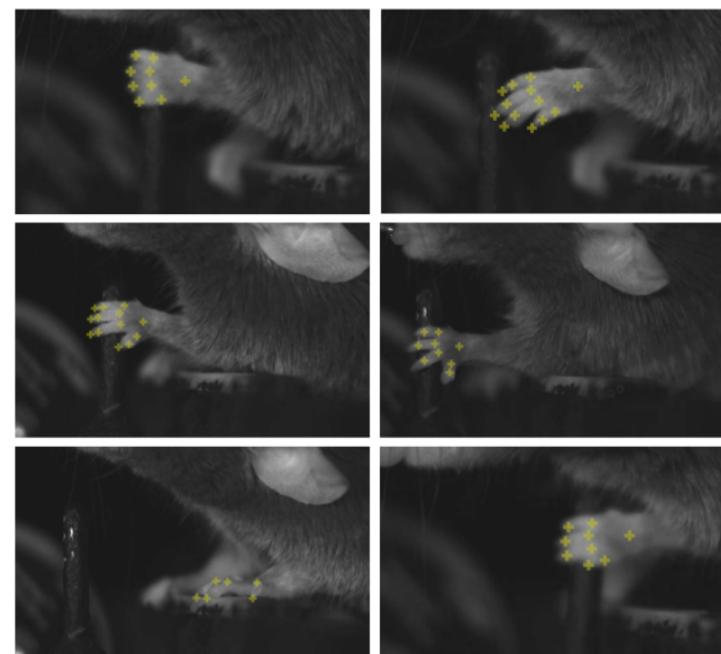
a

Extract characteristic frames to label



b

Label features in frames

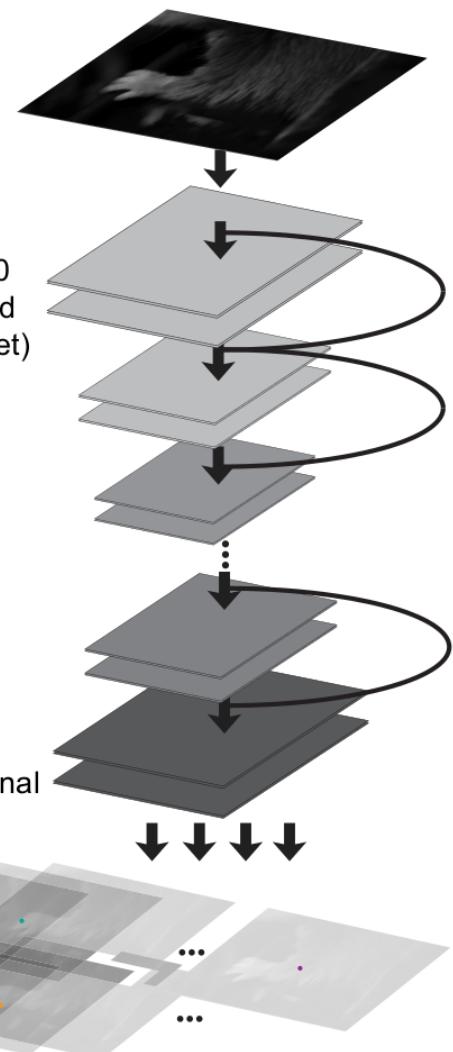


c

Train DNN

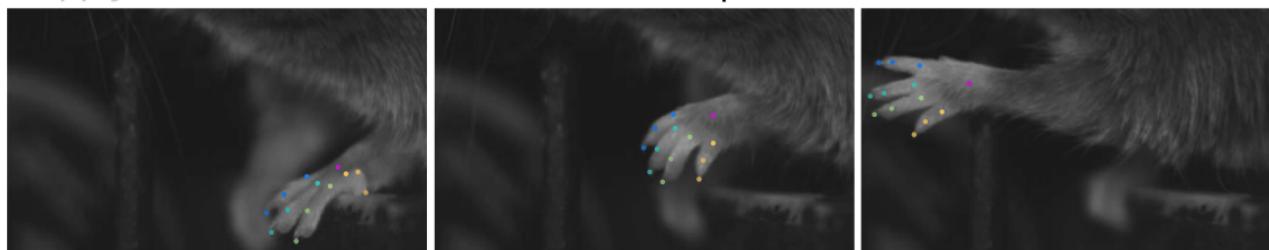
ResNet-50
(pre-trained
on ImageNet)

deconvolutional
layers



d

Apply to datasets: use trained network to predict labels

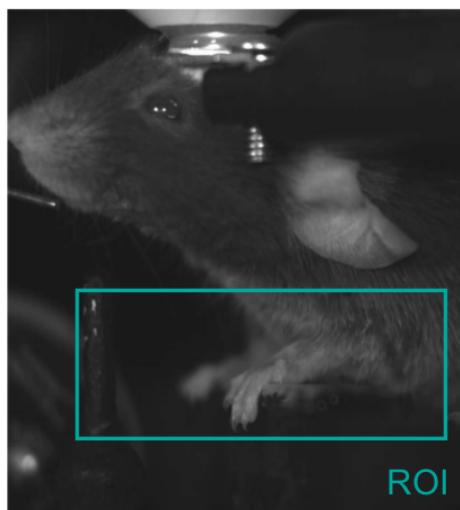


End-to-end training

DeepLabCut Toolbox

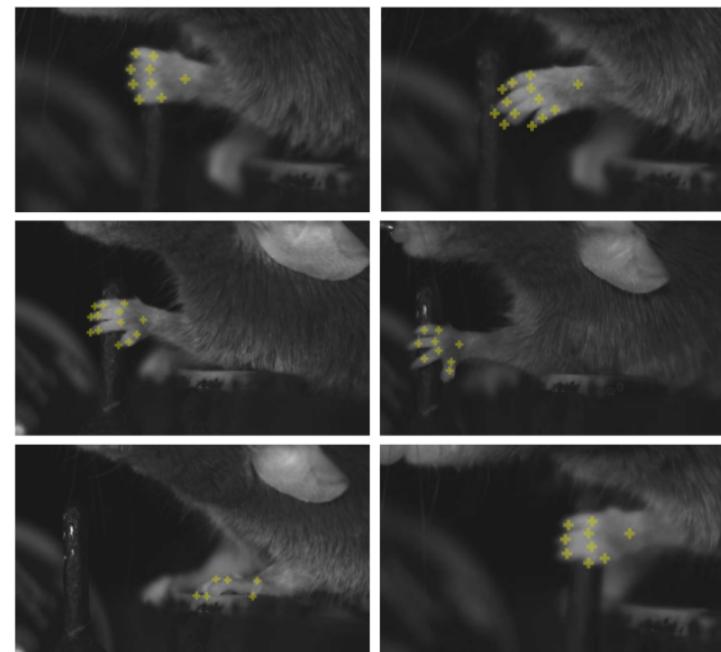
a

Extract characteristic frames to label



b

Label features in frames



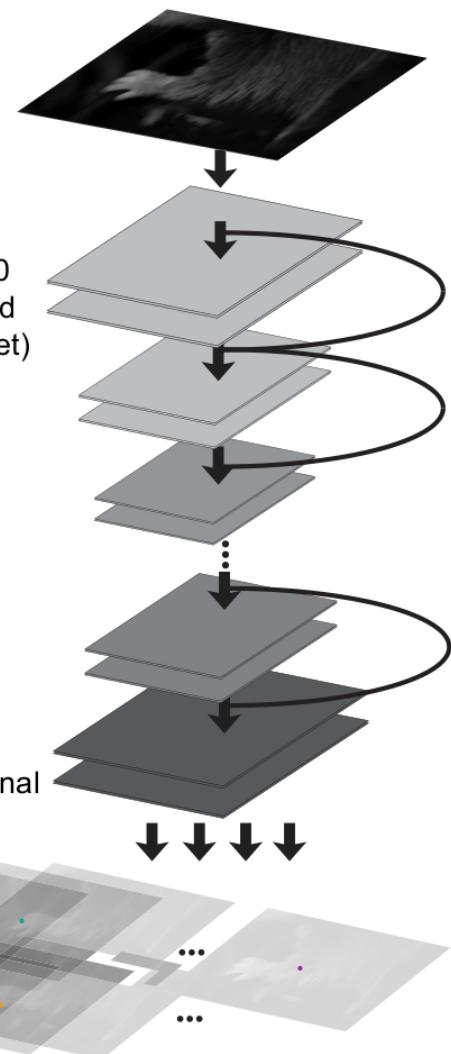
c

Train DNN

ResNet-50
(pre-trained
on ImageNet)

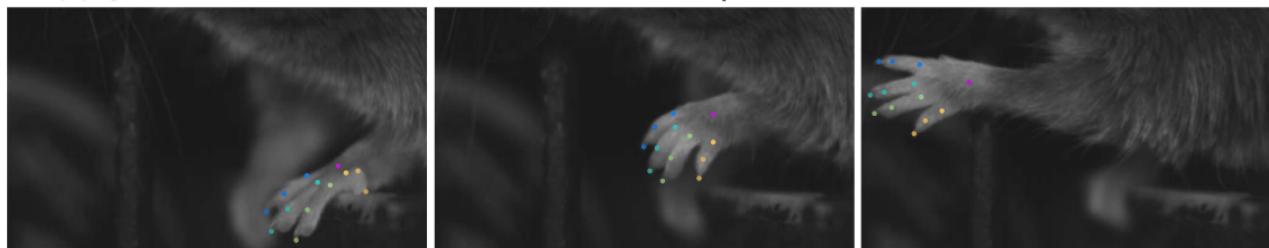


deconvolutional
layers

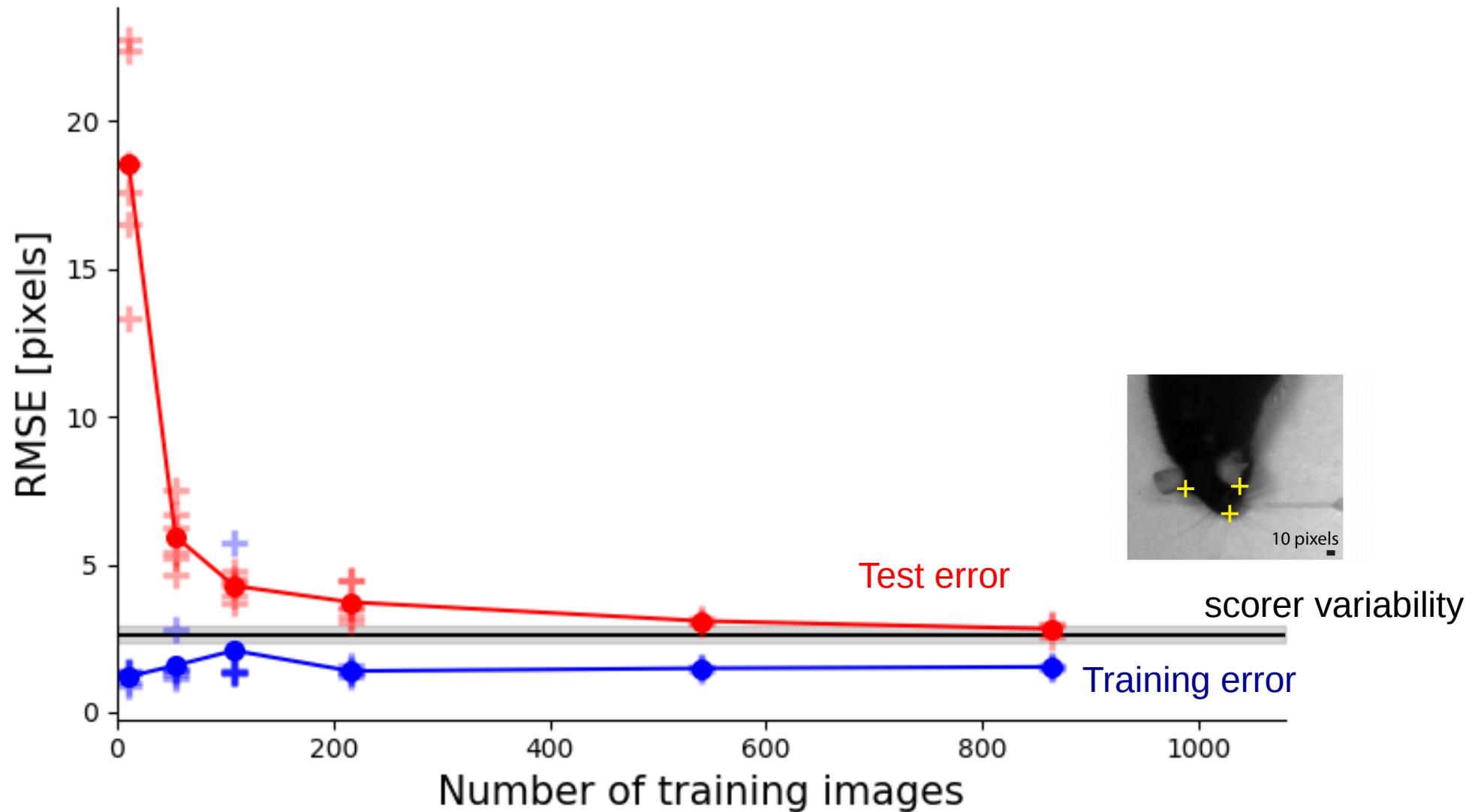


d

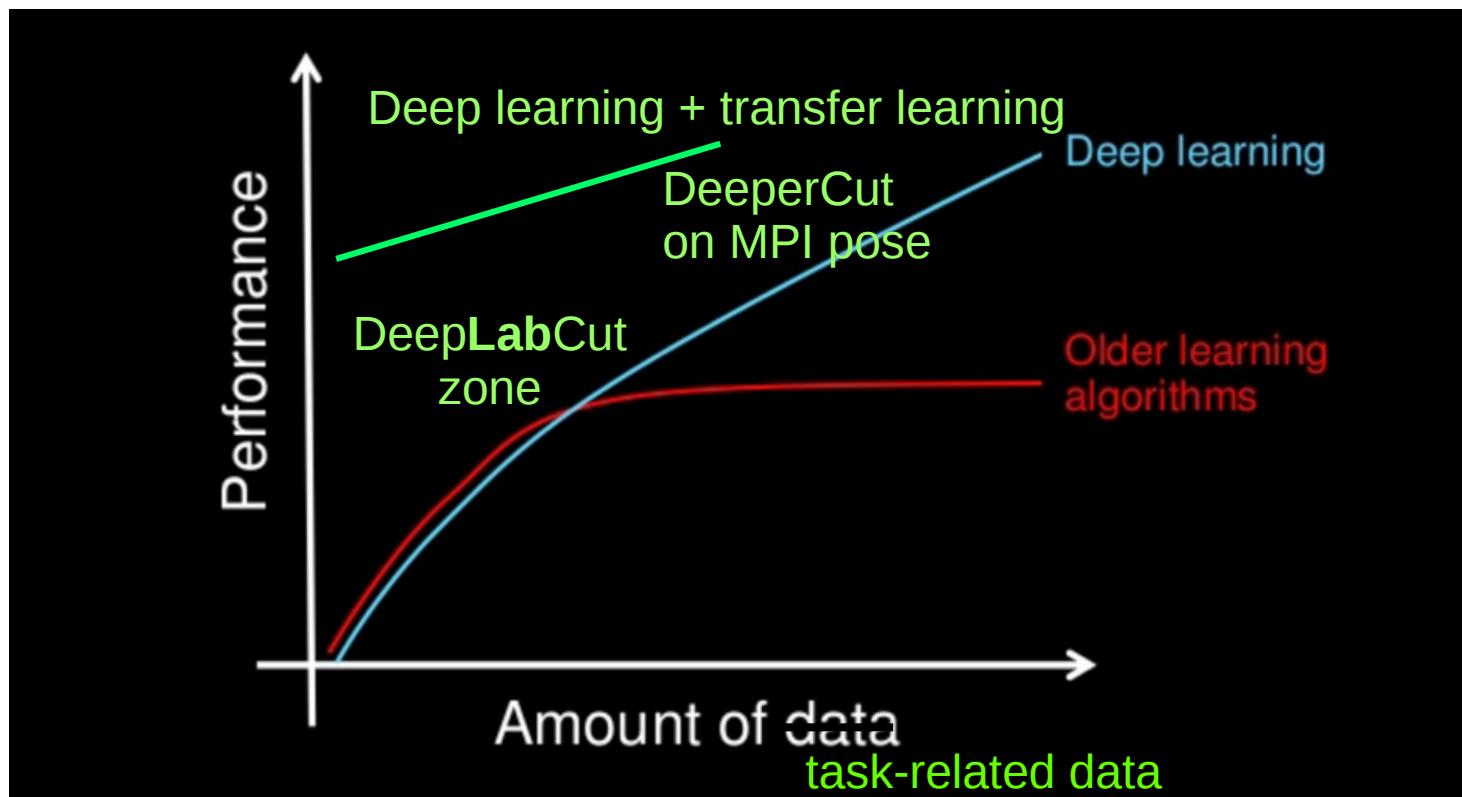
Apply to datasets: use trained network to predict labels



How much training data is required?



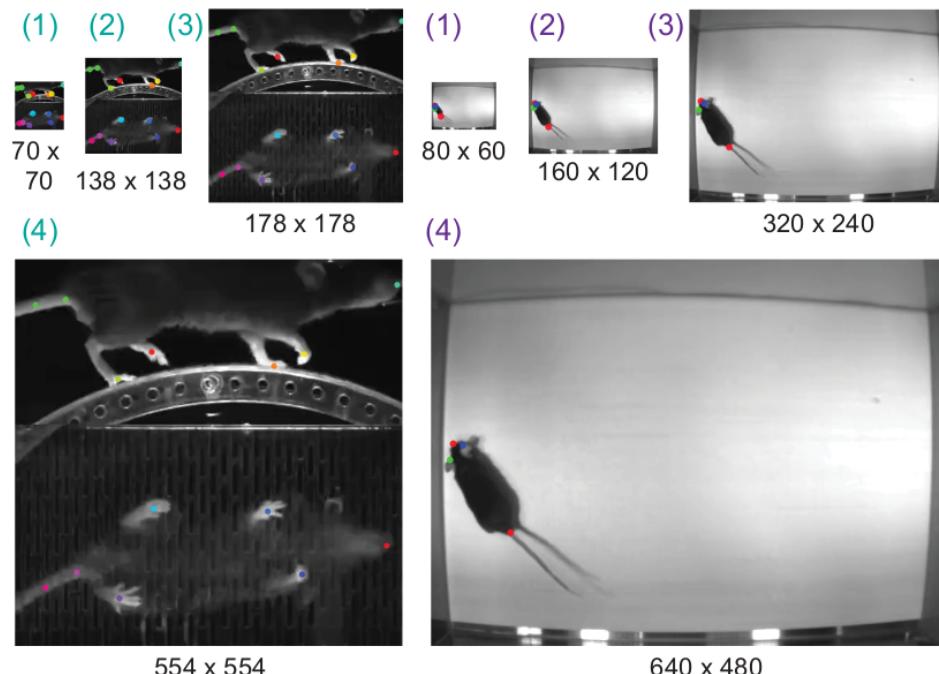
Transfer learning



Analysis speed

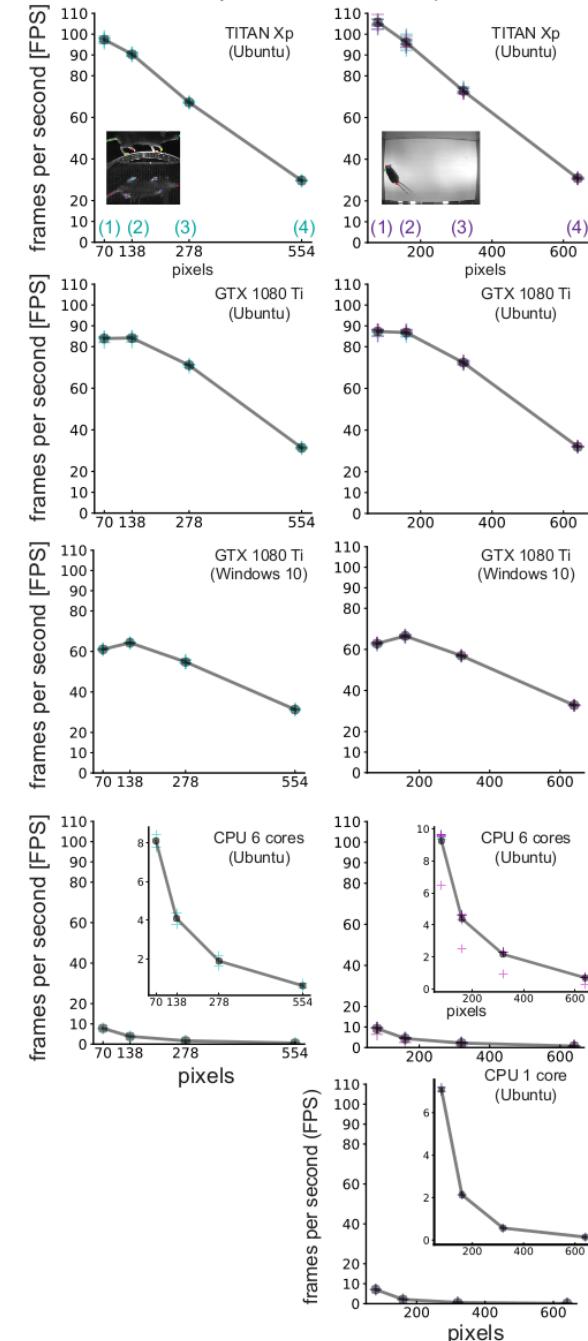
A

datasets used for testing

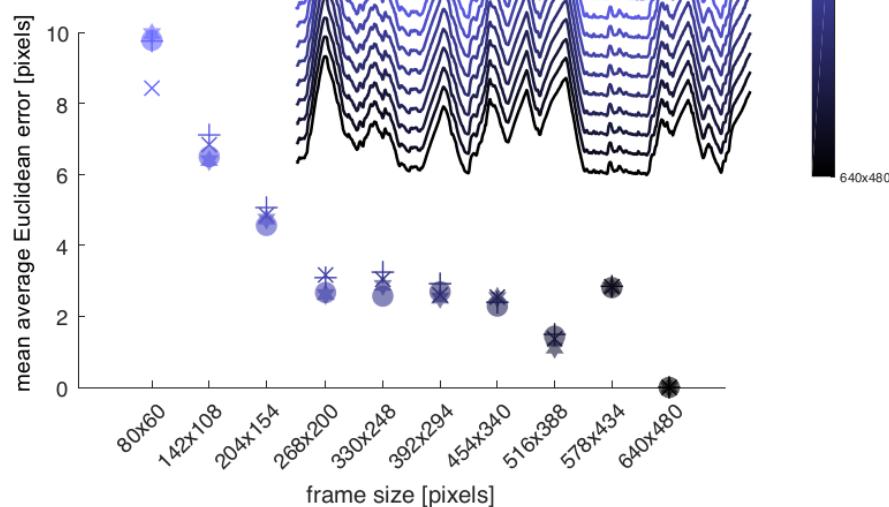


B

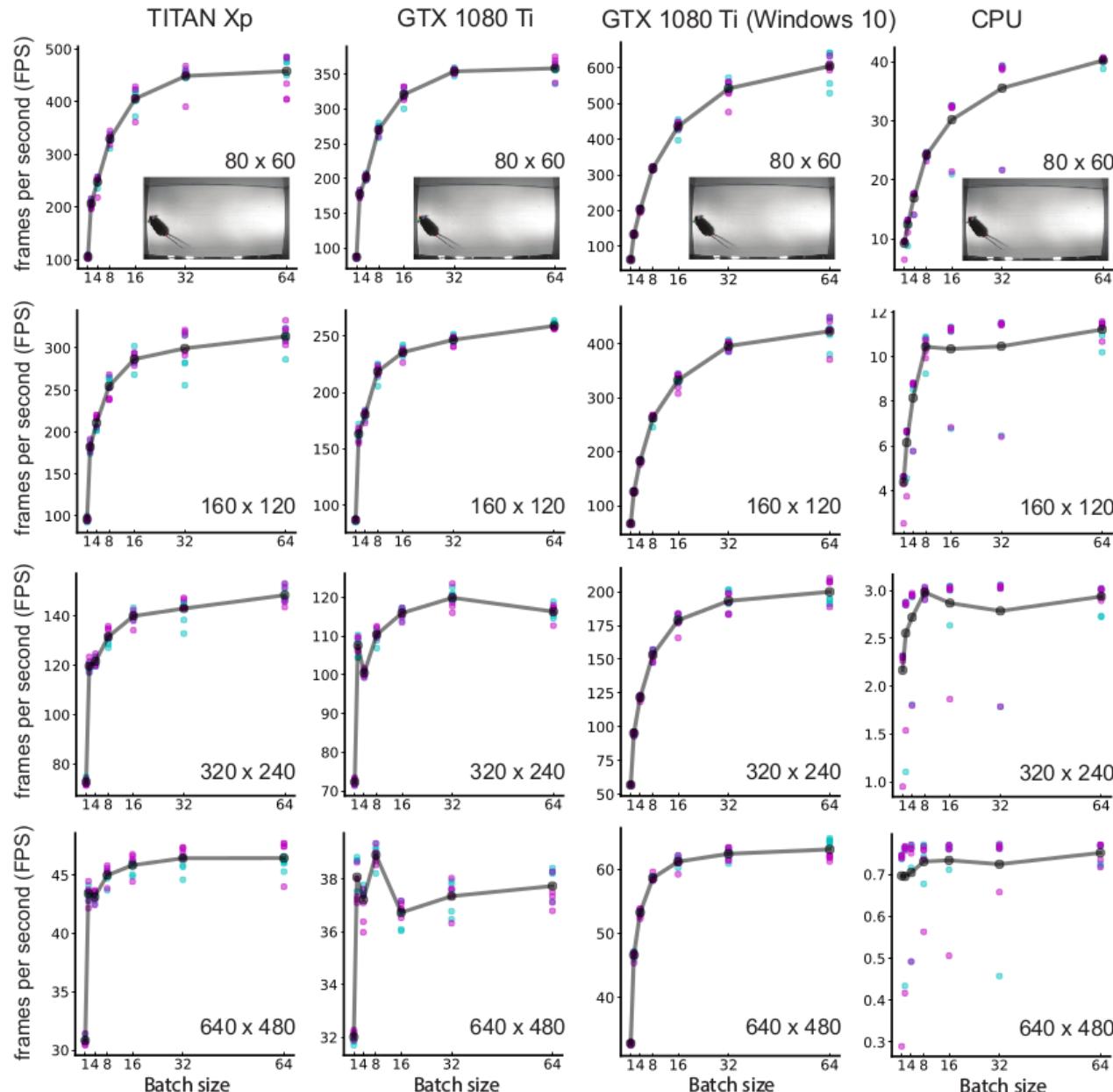
testing frame size vs. speed
(batch size = 1)



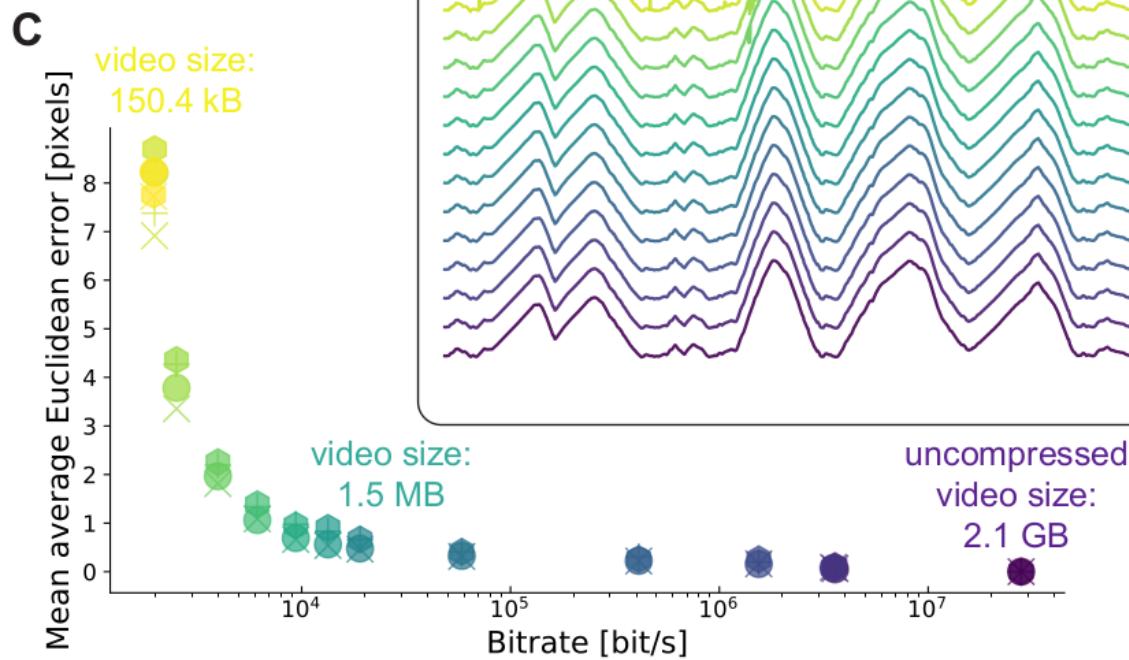
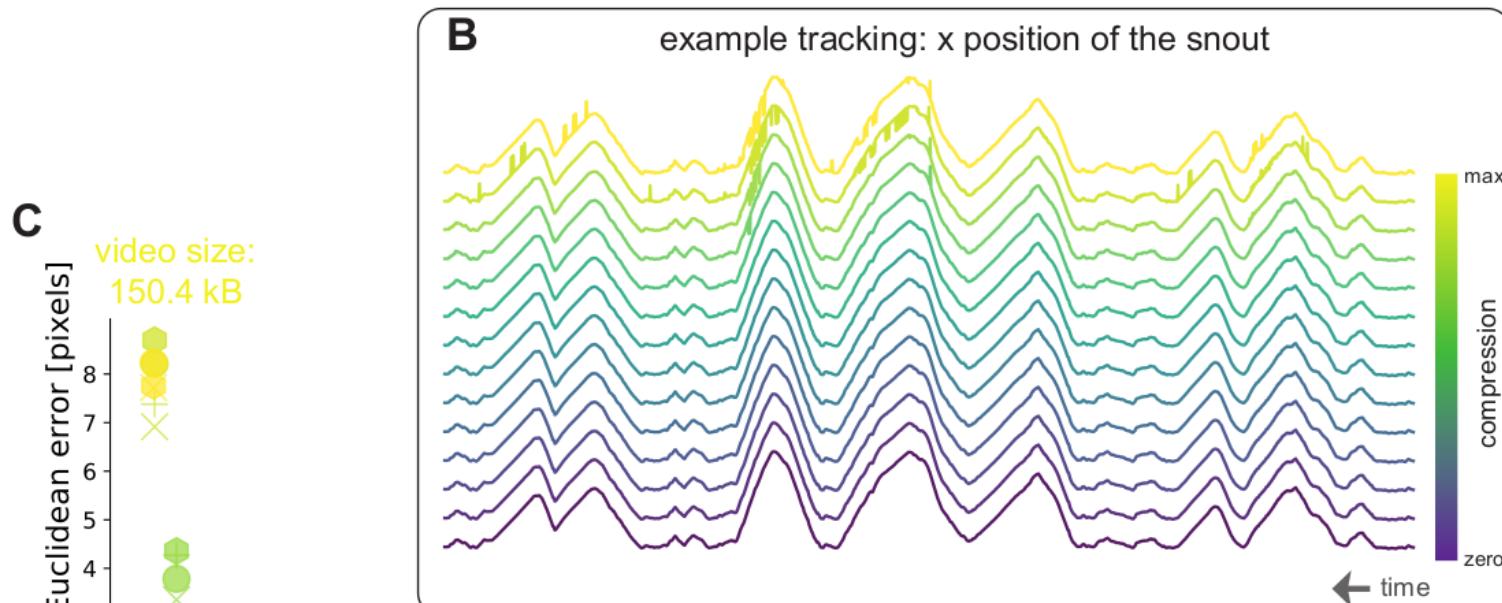
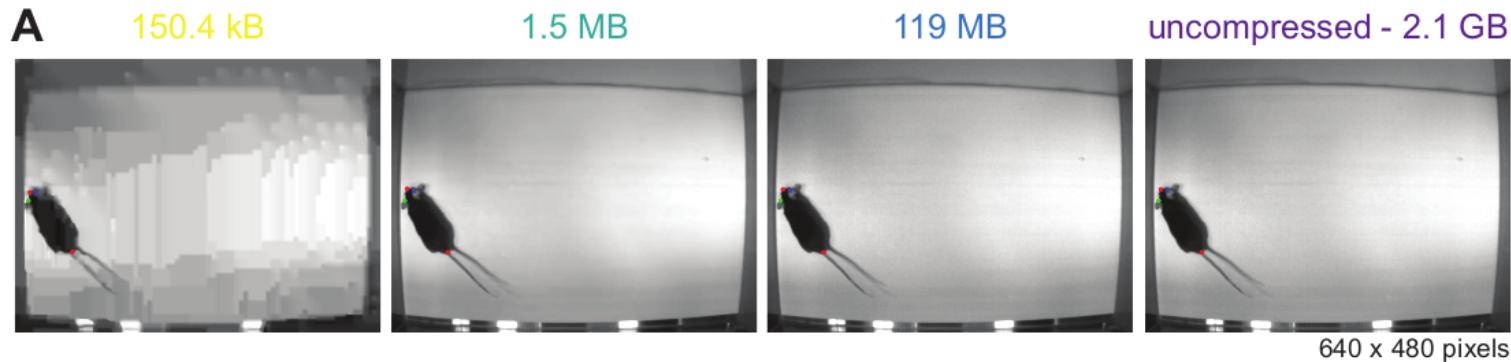
C



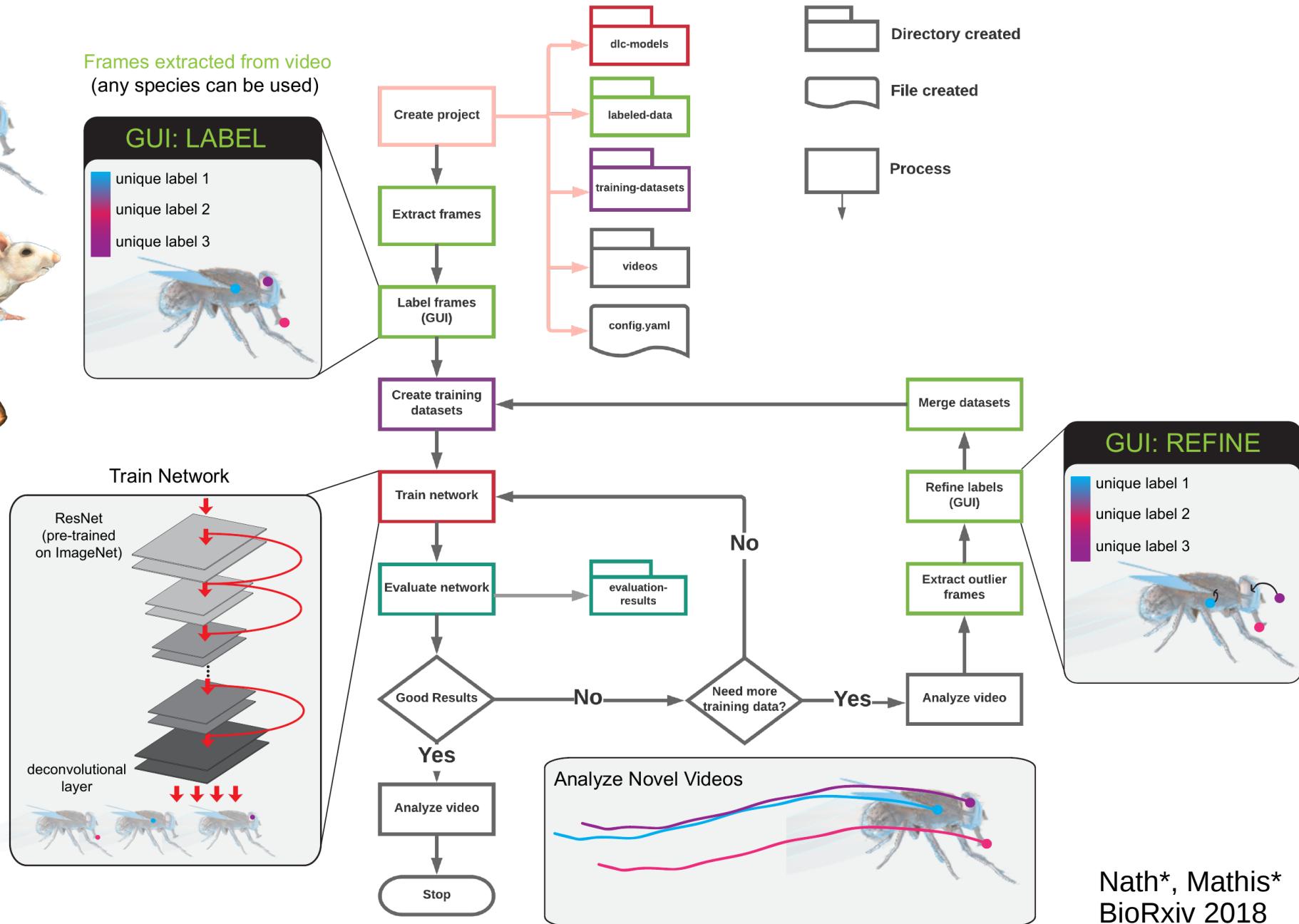
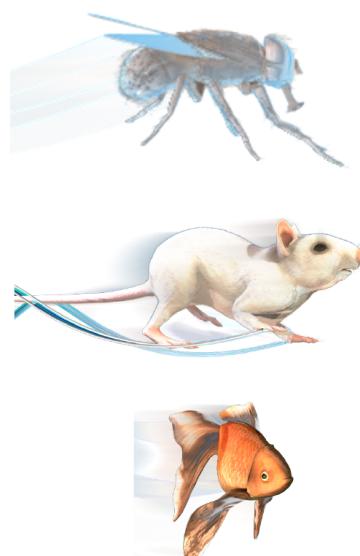
Analysis speed



Video compression robustness

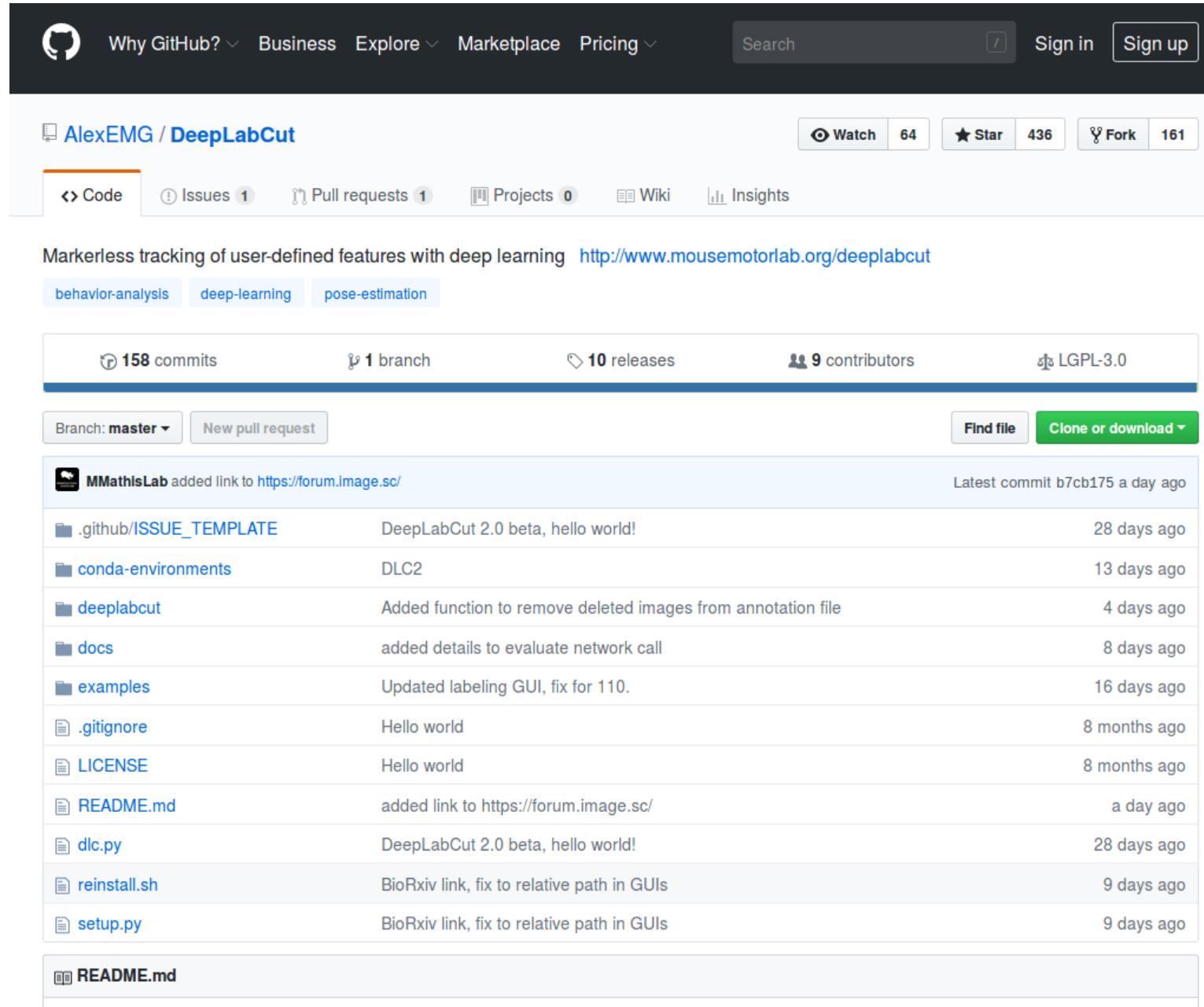


DeepLabCut 2.0 workflow



Nath*, Mathis*
BioRxiv 2018

DeepLabCut is an open-code project, so please get involved!



The screenshot shows the GitHub repository page for DeepLabCut. At the top, there's a navigation bar with links to Why GitHub?, Business, Explore, Marketplace, Pricing, a search bar, and options to Sign in or Sign up. Below the header, the repository name "AlexEMG / DeepLabCut" is displayed, along with a "Watch" button (64), a "Star" button (436), a "Fork" button (161), and a "Code" tab which is currently selected. Other tabs include Issues (1), Pull requests (1), Projects (0), Wiki, and Insights. A brief description of the project follows: "Markerless tracking of user-defined features with deep learning" and a link to <http://www.mousemotorlab.org/deeplabcut>. Below the description are several tags: behavior-analysis, deep-learning, and pose-estimation. Key statistics are listed: 158 commits, 1 branch, 10 releases, 9 contributors, and a license of LGPL-3.0. A dropdown menu shows the current branch is "master". There are buttons for "New pull request", "Find file", and "Clone or download". The main content area displays a list of recent commits, each with a small icon, the author's name, the commit message, and the time since the commit. The commits are as follows:

Author	Commit Message	Date
MMathisLab	added link to https://forum.image.sc/	Latest commit b7cb175 a day ago
	.github/ISSUE_TEMPLATE DeepLabCut 2.0 beta, hello world!	28 days ago
	conda-environments DLC2	13 days ago
	deeplabcut Added function to remove deleted images from annotation file	4 days ago
	docs added details to evaluate network call	8 days ago
	examples Updated labeling GUI, fix for 110.	16 days ago
	.gitignore Hello world	8 months ago
	LICENSE Hello world	8 months ago
	README.md added link to https://forum.image.sc/	a day ago
	dlc.py DeepLabCut 2.0 beta, hello world!	28 days ago
	reinstall.sh BioRxiv link, fix to relative path in GUIs	9 days ago
	setup.py BioRxiv link, fix to relative path in GUIs	9 days ago
	README.md	

Apr 8, 2018 – Dec 4, 2018

Contributions Commits ▾

Contributions to master, excluding merge commits



- clarify the documentation
- add additional functions
- respond to user questions
- ...

Code contributors:

Alexander Mathis, Tanmay Nath, Mackenzie Mathis, and especially the authors of DeepCut authors for the feature detector code. The feature detector code is based on Eldar Insafutdinov's TensorFlow implementation of DeepCut. DeepLabCut is an open-source tool and has benefited from suggestions and edits by many individuals including Richard Warren, Ronny Eichler, Jonas Rauber, Hao Wu, Federico Claudi, Taiga Abe, and Jonny Saunders as well as the [contributors](#). In particular, the authors thank Ronny Eichler for input on the modularized version. We are also grateful to all the beta testers!

This is an actively developed package and we welcome community development and involvement!

Slack group

#helpdesk

☆ | 8 152 | 1 For code bugs, please check: <https://github.com/AlexEMG/DeepLabCut/issues>. He... Thursday, November 29th

AlexEMG/DeepLabCut
Markerless tracking of user-defined features with deep learning -
AlexEMG/DeepLabCut

Jxwang59 1:18 PM
Hi, everyone. Just a basic question! How to load a created project? Thank you in advance! 😊

mackenziewmathis 1:22 PM
I'm not sure I understand the question; i.e. if you create a project and work on it, then close the python session, you just import deeplabcut again, and define the config-path then you can keep working on it

Jxwang59 1:28 PM
@mackenziewmathis Thanks!

Raisa Rahim 8:42 PM
I'm trying to run Demo_yourowndata on my Mac. I'm running pythonw through my terminal (to bypass the incompatibility of wxPython and jupyter). I get up to label frames when I get the "AttributeError: 'MainFrame' object has no attribute 'dir'" and an empty window opens. When I go to "load extracted frames", all the .png files are greyed out. Thanks in advance!

mackenziewmathis 8:58 PM
Are the frames grey in the folder outside of deeplabcut ?

Feng 11:14 AM
Message #helpdesk

21 replies Last reply 3 days ago

Friday, November 30th

Support

<https://forum.image.sc/tags/deeplabcut>

Image.sc Forum - Mozilla Firefox

Image.sc Forum https://forum.image.sc

image.sc

All Topics BoneJ CellProfiler Cytomine DeepLabCut Fiji ilastik ImageJ NEUBIAS OpenSPIM scikit-image SLIM Curve Your Icon Here

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all categories ▾ all tags ▾ Latest New (8) Unread Top Categories Unanswered + New Topic

Topic	Category	Users	Replies	Views	Activity
Welcome to the Image.sc Forum!	Announcements	1	1.1k	Aug 2	

Welcome to the Scientific Community Image Forum at forum.image.sc! This forum's focus is software-oriented aspects of scientific imaging, particularly (but not limited to) image analysis, processing, acquisition, storag... [read more](#)

DLC utils...

AlexEMG / DLCutils

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

Various scripts to support deeplabcut... Edit

deeplabcut behavior-analysis clustering-algorithm Manage topics

15 commits 1 branch 0 releases 3 contributors

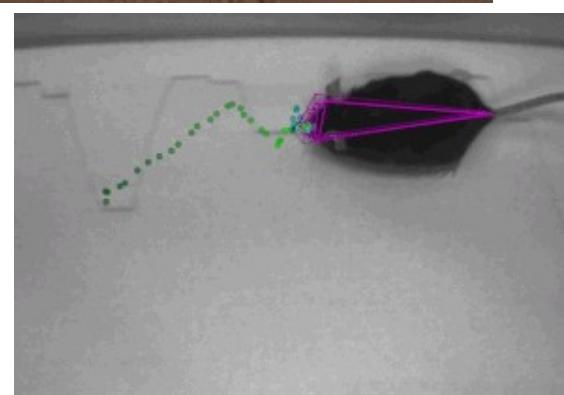
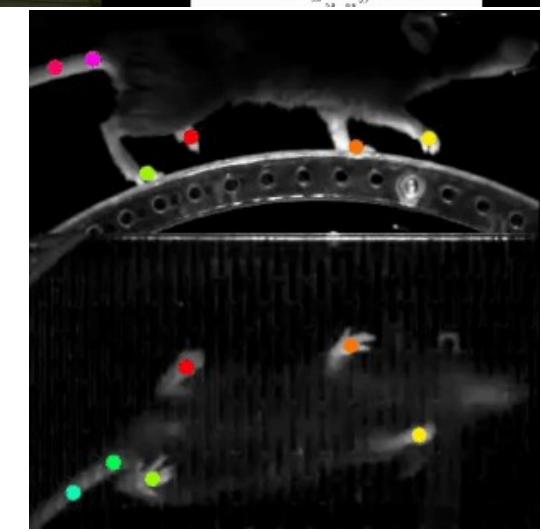
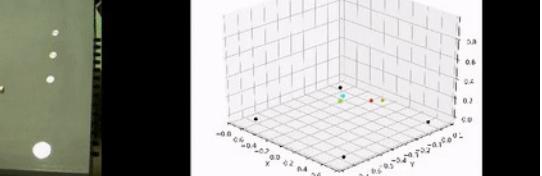
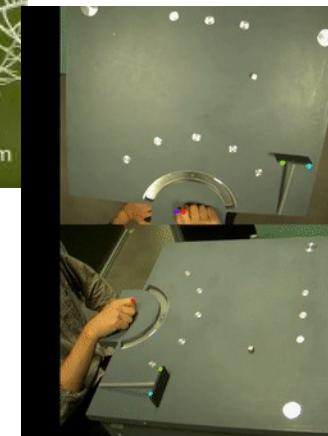
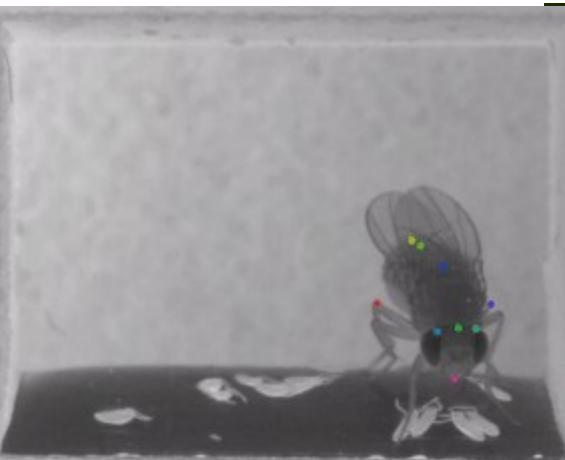
Branch: master ▾ New pull request Create new file Upload files Find file Clone or download ▾

MMathisLab	Update README.md	Latest commit c331be7 4 days ago
DLCL_2_MotionMapper	DeepLabCut into MotionMapper	29 days ago
README.md	Update README.md	4 days ago
conda-environment-cheatsheet	Create conda-environment-cheatsheet	a month ago
convertDLC1TO2.py	Update import file	23 days ago
time_in_each_roi.py	added scipy import	8 days ago
README.md		

Questions?

Individual references see

<http://www.mousemotorlab.org/deeplabcut>



Acknowledgements



Mackenzie Mathis (Harvard)
Matthias Bethge (Uni Tuebingen)



A.M & Venkatesh N. Murthy (trail tracking / Harvard)
Mackenzie Mathis & Naoshige Uchida (mouse reaching/ Harvard)
Kevin Cury & Richard Axel (egg laying / Columbia)
Amir Patel & An Chi Chen (Cheetah / U of Cape Town)

Tanmay Nath (DLC 2.0 code / Rowland Institute, Harvard)
Richard Warren (Speed benchmarking / Columbia)

Pranav Mamidanna (labeling / Uni Tuebingen)
Taiga Abe (labeling / Columbia)

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NVIDIA GPU grant 2017, 2018
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WATB/Project ALS Fellowship 2017
Rowland Fellowship

