Automated locomotion score from video

Deep learning keypoint detection in video images

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Wageningen UR, Agro Food Robotics

Breed4Food symposium

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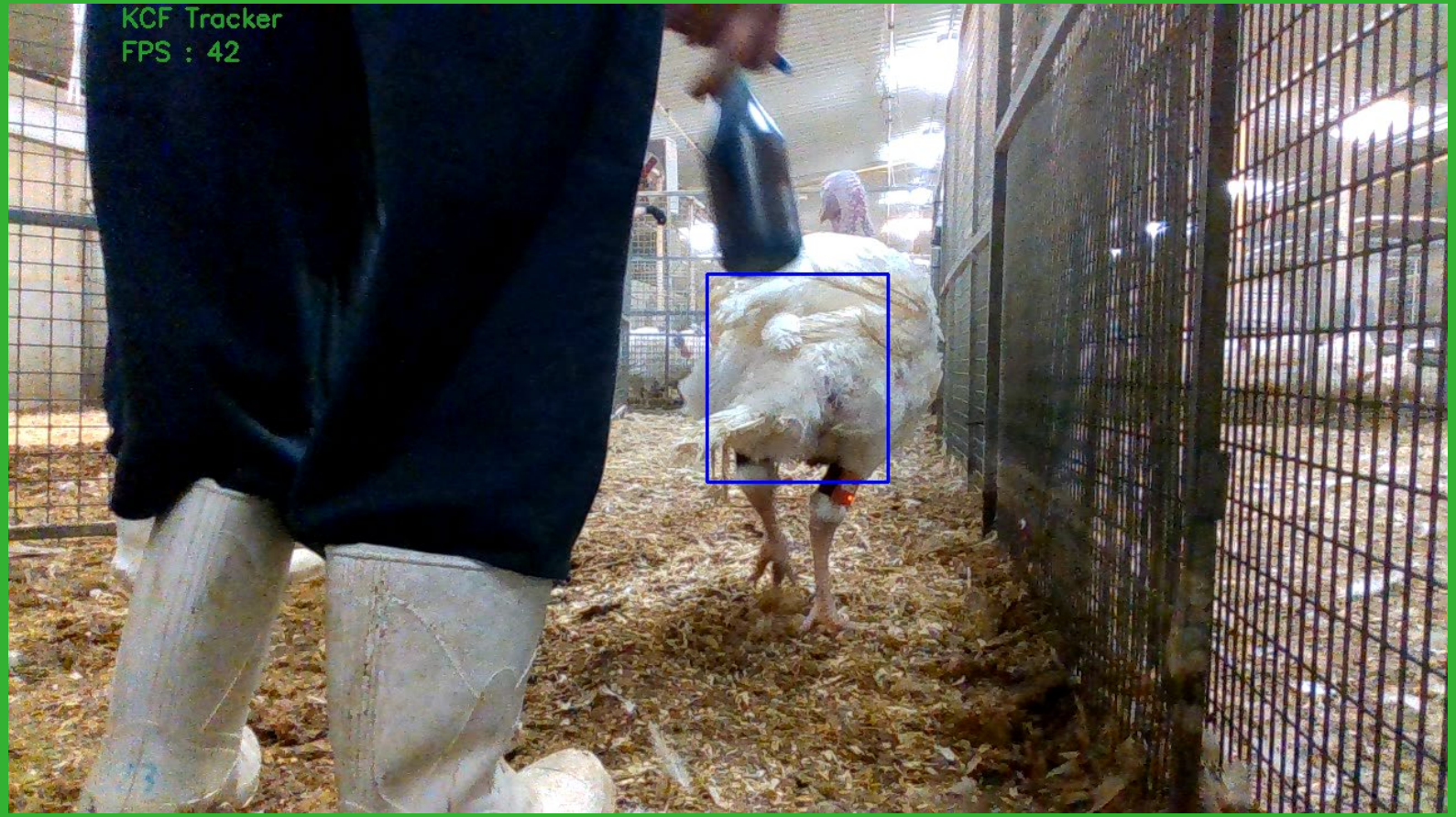
100years
1918 — 2018

Determine locomotion score from video

- Method development is the first step in data analysis
  - Separate the interesting objects
  - Determine properties or features of the objects
  - Gather the data
  - Compare with other scores
  - Summarize results
- Separation of objects and determination of features combined in **deep learning pose estimation**

Classical approach - results for blob detection

First results in analysis - tracking



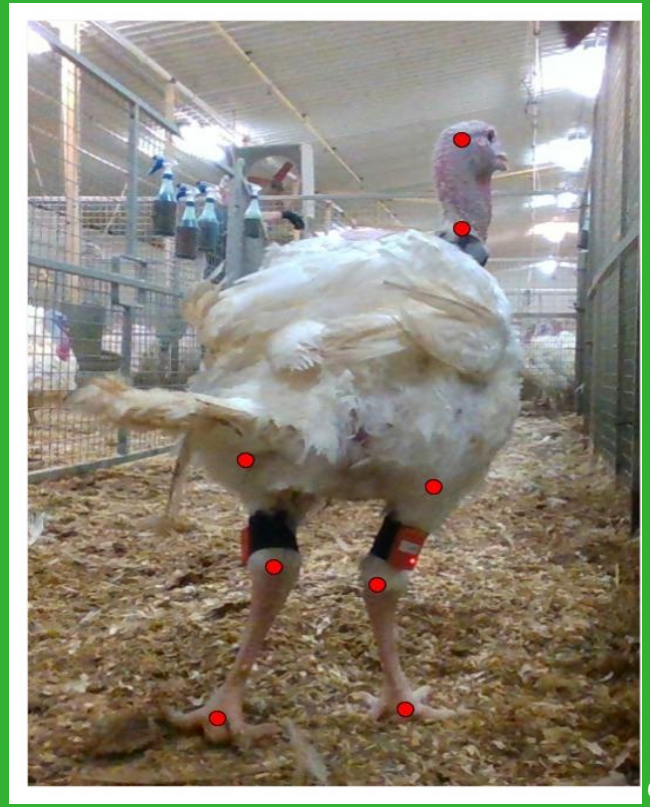
Classical vs deep learning pose estimation

- No static thresholds anymore
- User input on setting thresholds changes into annotation that can be generalised
- https://alexemg.github.io/DeepLabCut/

- Good tutorials, easy setup, well maintained online
- Training and classification on GPU, speeds up calculation times

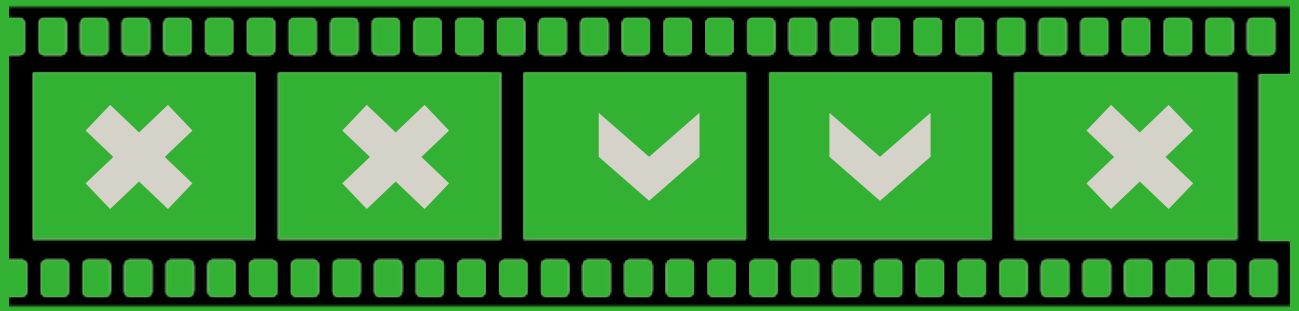
How to implement pose estimation in video?

- Determine skeleton joint positions or bodyparts
- Feet L, R
- Heel L, R
- Knee L, R
- Neck
- Head

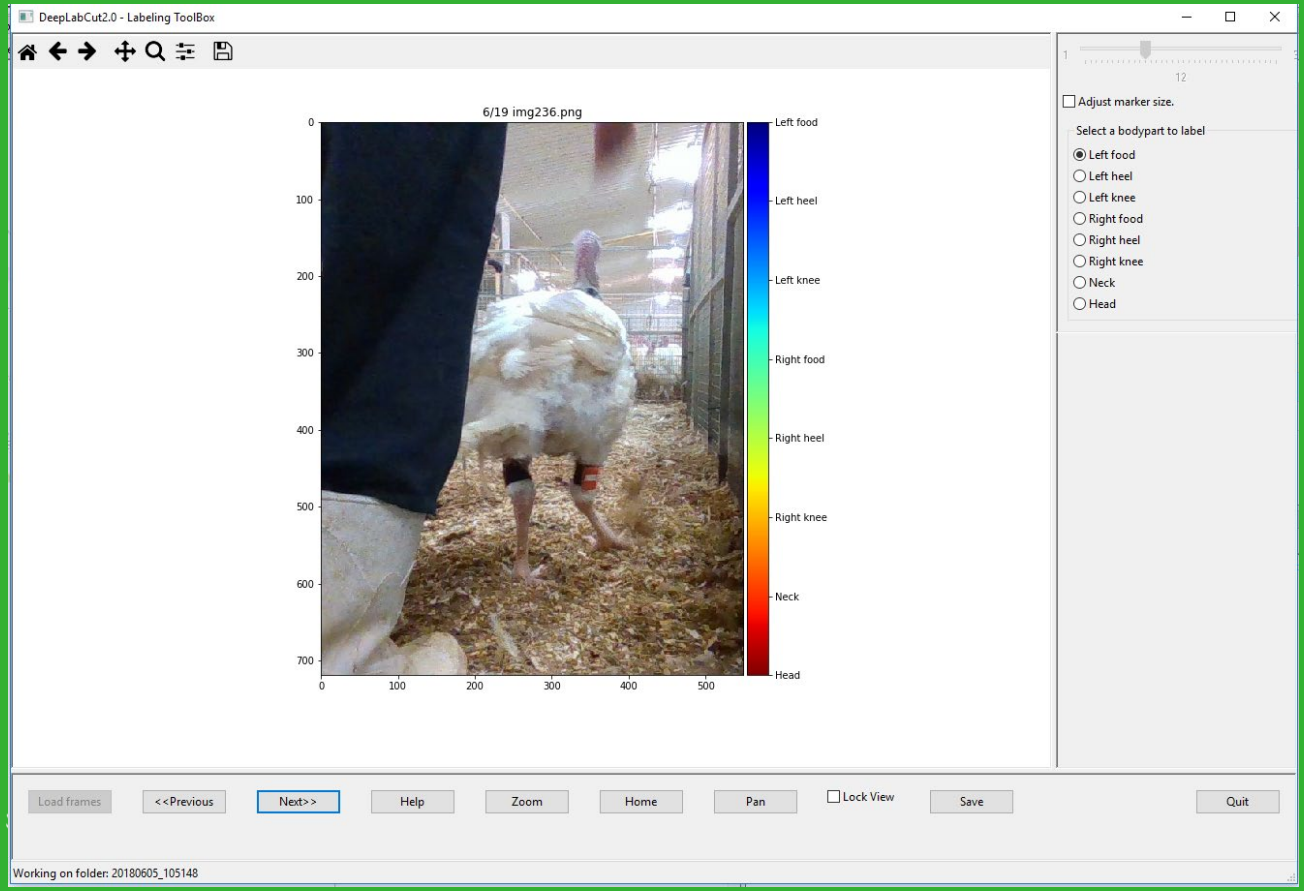


Frame selection from movies for annotation

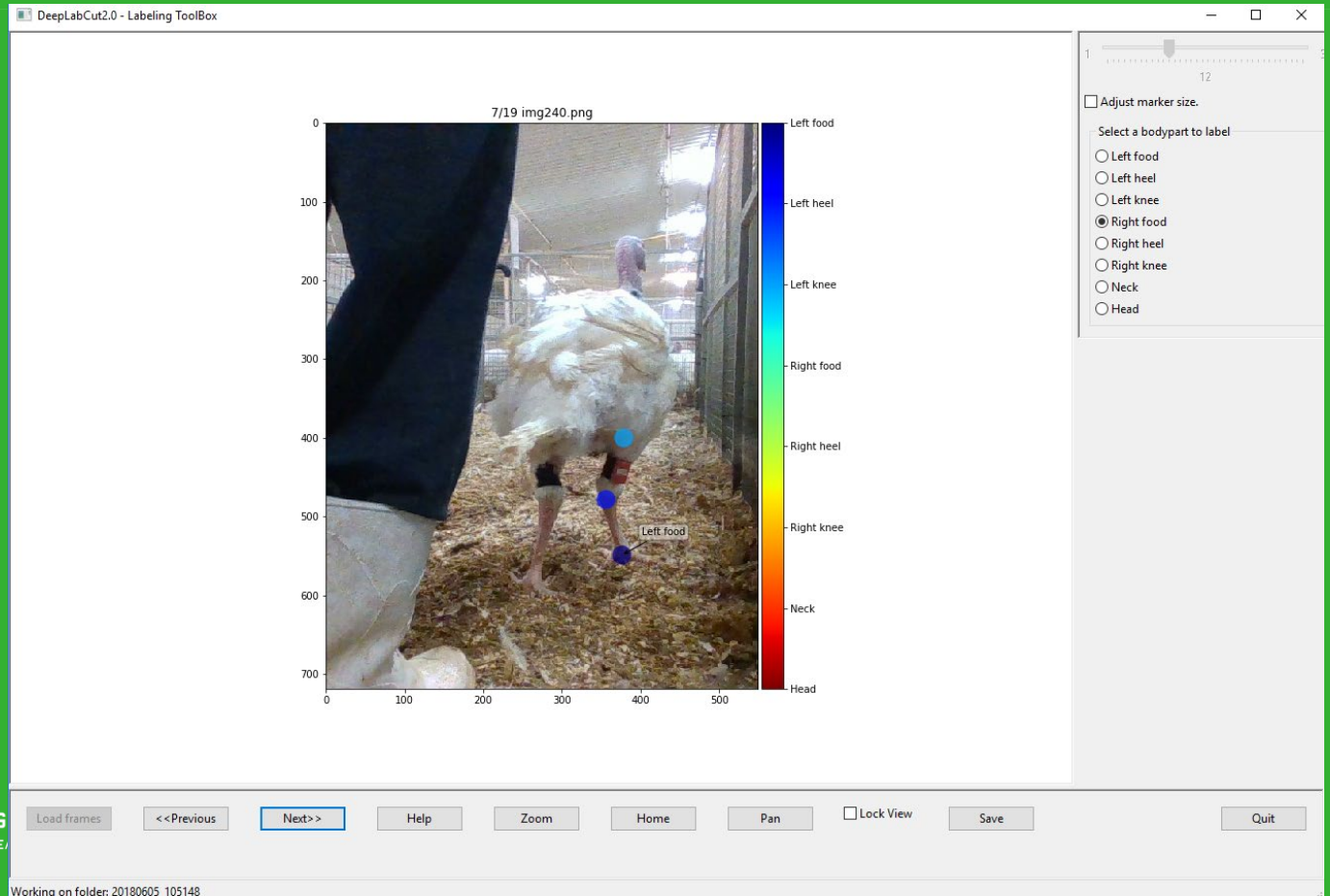
- From movies frames are selected by automatic algorithm, such that maximum variability is achieved in training and annotation data



Annotation of data by Python GUI interaction - 1



Annotation of data by Python GUI interaction - 2



Annotation data

- From each movie 20 frames were annotated, 12 movies total
- 8 clicks for each joint in a frame. 8x20x12=1920 clicks total
- This is very minimal with respect to the results achieved!

Annotation data looks like (pixel coordinates):

bodyparts	Left food	Left food	Left heel	Left heel	Left knee	Left knee	Right fooc	Right fooc	Right heel	Right heel	Right knee	Right knee	Neck	Neck	Head	Head
coords	x	y	x	y	x	y	x	y	x	y	x	y	x	y	x	y
labeled-data\20180605_121322\img013.png																
labeled-data\20180605_121322\img019.png																
labeled-data\20180605_121322\img020.png																
labeled-data\20180605_121322\img048.png																
labeled-data\20180605_121322\img049.png																
labeled-data\20180605_121322\img064.png																
labeled-data\20180605_121322\img105.png													308.296	153.3929	288.1398	82.84608
labeled-d	380.1026	638.4026	362.4659	567.8557	380.1026	503.6077	271.7628	671.1565	274.2824	582.9729	252.8663	517.4651	322.1534	274.3304	313.3351	215.1214
labeled-d	381.3624	639.6624	375.0636	569.1155	396.4796	512.4261	317.1144	628.3245	329.712	566.596	308.296	512.4261	356.1671	261.7328	352.3878	216.3812
labeled-d	373.8038	640.9221	359.9464	557.7776	383.8819	494.7894	323.4132	628.3245	323.4132	562.8167	309.5558	506.1272	362.4659	264.2523	356.1671	225.1996
labeled-d	468.2862	574.1546	455.6886	521.2444	470.8057	479.6722	396.4796	582.9729	398.9991	523.764	388.921	479.6722	421.6749	279.3695		
labeled-d	470.8057	576.6741	451.9093	522.5042	467.0265	480.9319	393.9601	581.7132	397.7394	517.4651	395.2198	480.9319	427.9737	269.2914		
labeled-d	434.2726	502.3479	433.0128	460.7757	440.5714	434.3206	390.1808	469.594	402.7784	453.2171	386.4015	434.3206	406.5577	308.3441	405.2979	283.1488
labeled-d	402.7784	472.1136	401.5187	453.2171	400.2589	433.0608	375.0636	477.1526	375.0636	454.4769	364.9855	433.0608	383.8819	329.7601		
labeled-data\20180605_121322\img349.png																
labeled-data\20180605_121322\img364.png																

Training of the algorithm after annotation

- Deep learning GPU machine
  - Trained overnight and during weekend
- Can also be done on HPC Annuna from WUR

- Do not look at the size of the markers, they do not scale
- It is all about the position of the joints that have been detected

Result movies

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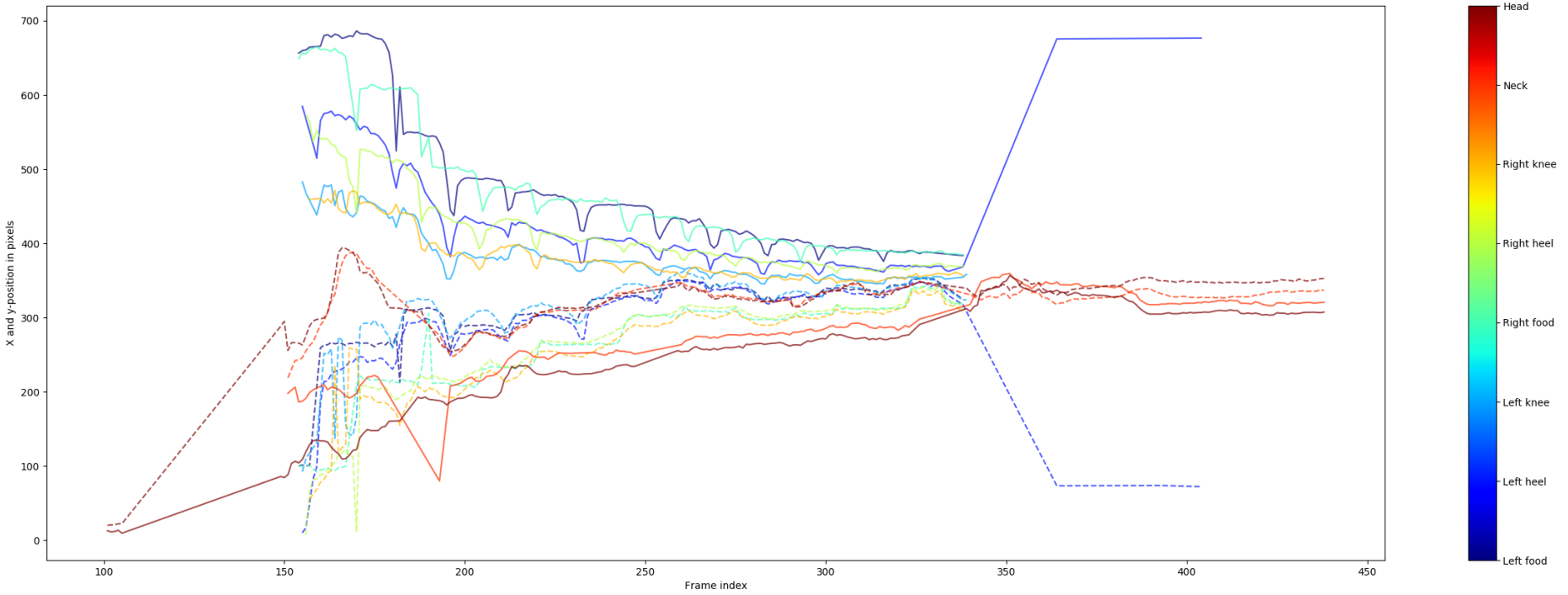
Moving objects do not always interfere!

- This is very good!
- Still complete skeleton available

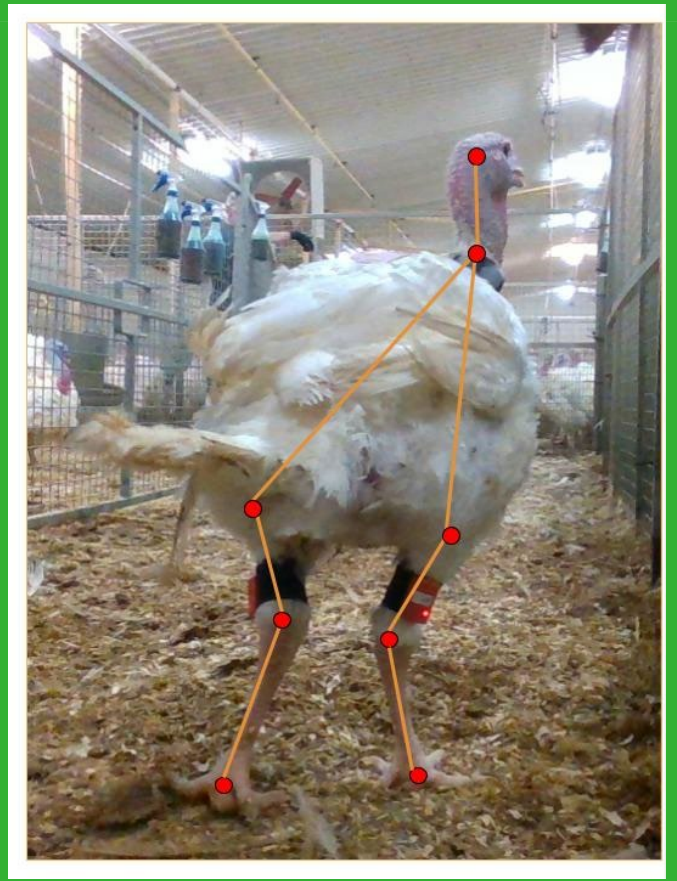
Time series of position of joint through movie

- Lines converge, due to scaling



Next steps in analysis

- Connect the joints when skeleton is complete
- Determine scale invariant parameters, e.g. angles, angle changes
- Prepare time series, identical to step analysis



Questions and suggestions

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