Individual Pig Tracking and Behaviour Monitoring with Deep Learning

Jake Cowton, Dr. Jaume Bacardit & Prof. Ilias Kyriazakis

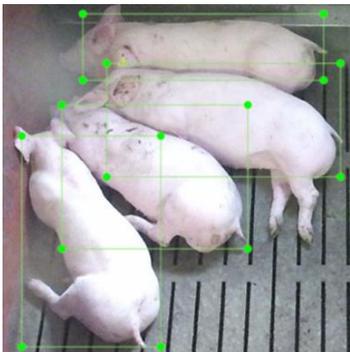29/08/19

Presented by Dr Ali Alameer

Overview

- Transition away from pen-level treatment to individual-level

- Developed a system to localise & track individual pigs
  - Without marking or tagging the pigs

- Extract behavioural metrics from individual pig tracks

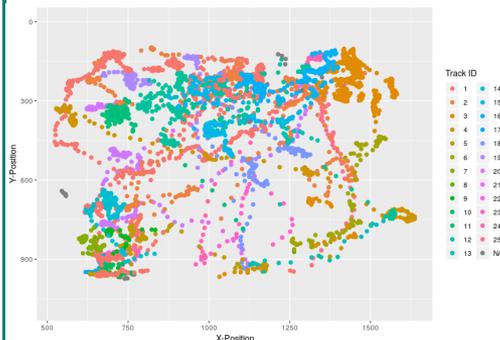- Use for individual-level assessment & treatment

Datasets

Pig Detection

Bounding boxes of pigs in images

- 1,646 images
- 9,014 annotations

Pig Tracking

Location of individual pigs across a video

- 25 pig tracks
- 7.8 minute video @ 4 FPS
- 1,874 frames

Pig Re-ID

Sets of images of the same pig

- 25 pig identities
- 5,653 total images
- Resized to 128 x 256

Implementation

Faster R-CNN

An object detection method for localising and classifying objects within in an image

Uses the Pig Detection dataset

+

Deep SORT

Uses the trajectory and visual appearance of detected objects to track each of them between frames

Uses the Pig Tracking & Re-ID datasets

+

Behavioural Metric Extraction

Using the tracks from Deep SORT we extracted metrics about each pig's activity: distance travelled, average speed, time spent idle

Uses metrics extracted from the Pig Tracking dataset

Full Workflow

Label Training Data	Faster R-CNN	Deep SORT	Apply to Test Dataset	Extract Behaviours from tracks

Label Training Data
- Draw regions of interest around each pig
- Assign an ID to each pig

Faster R-CNN
- Faster R-CNN pretrained on ImageNet, then trained on Pascal VOC 2007 datasets
- Faster R-CNN trained on pig detection dataset using transfer learning

Deep SORT
- Deep SORT trained to re-identify humans using visual appearance (MARS dataset)
- Deep SORT trained to re-identify pigs based on visual appearance using Pig Re-ID dataset

Apply to Test Dataset
- Faster R-CNN & Deep SORT are applied to the Pig Tracking dataset

Extract Behaviours from tracks
- Individual behaviour metrics are extracted from the tracks
- These are evaluated against the ground truth tracks

Results - Detection

Overall

0.901 mAP

Many pigs
>10 pigs in image
0.905 mAP

Densely packed
4 or more overlapping pigs
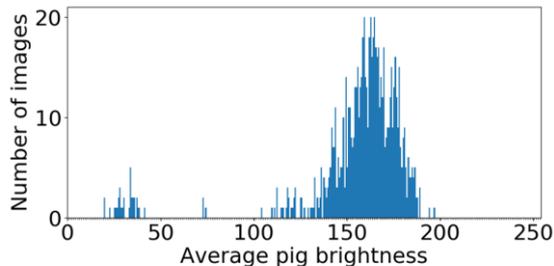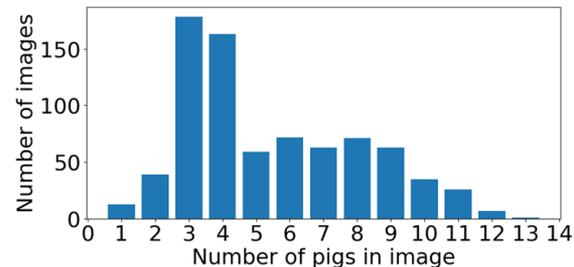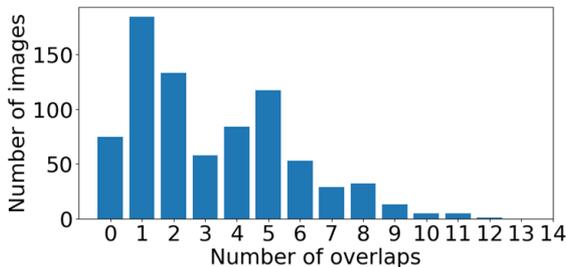0.906 mAP

Overexposed
Bright sunlight distorts the image
(manually selected)
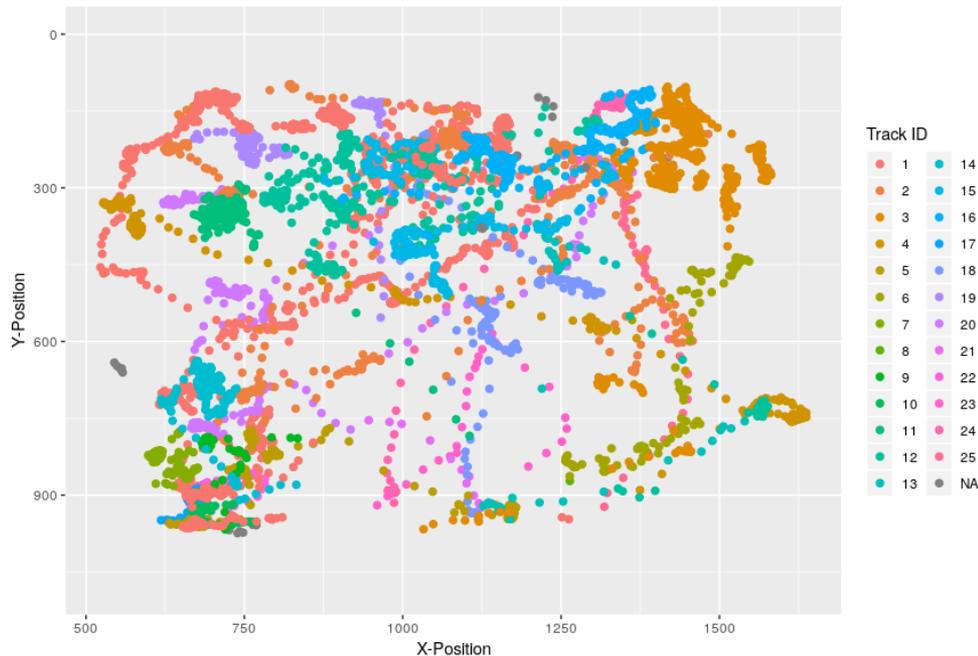0.906 mAP

Low-light
Average pig brightness < 100
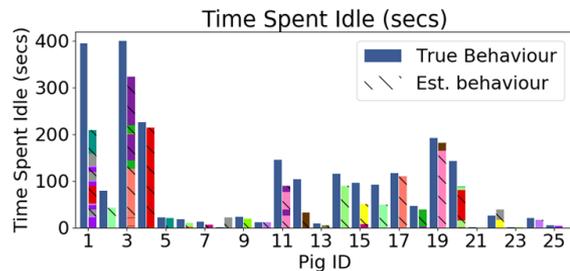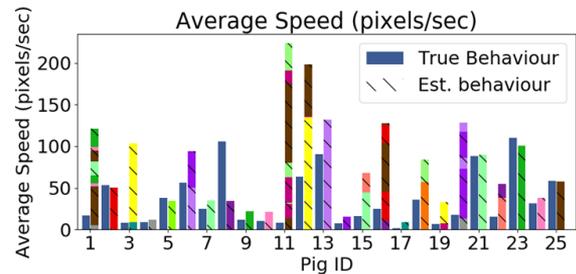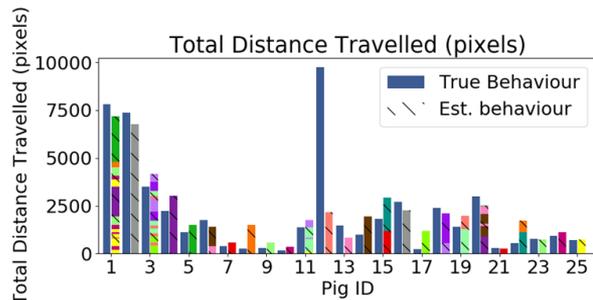0.850 mAP

Results - Detection

Results - Tracking

- ## MOTA 0.95
  - *How well we track multiple pigs*

- ## IDF1 0.73
  - *How well we retain IDs of individual pigs*

Results - Behaviour Extraction

- Total Distance Travelled
  0.015 MSE

- Time Spent Idle
  0.008 MSE

- Average Speed
  0.008 MSE

Summary

- Moving away from pen-level to pig-level treatment and care

- We are able to detect pigs in very challenging scenarios

- Tracking of pigs is enabled through trajectory & visual-based metrics

- We can use tracks to extract accurate behavioural metrics

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