Animal Tracking and Annotation

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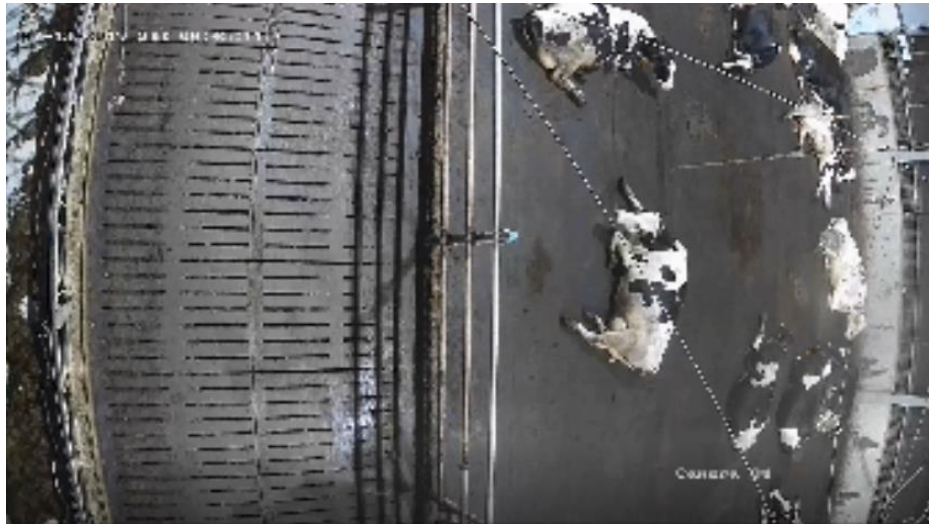
Background

Cameras in barn offers continuous check on animals
Overview on all animal's well-being

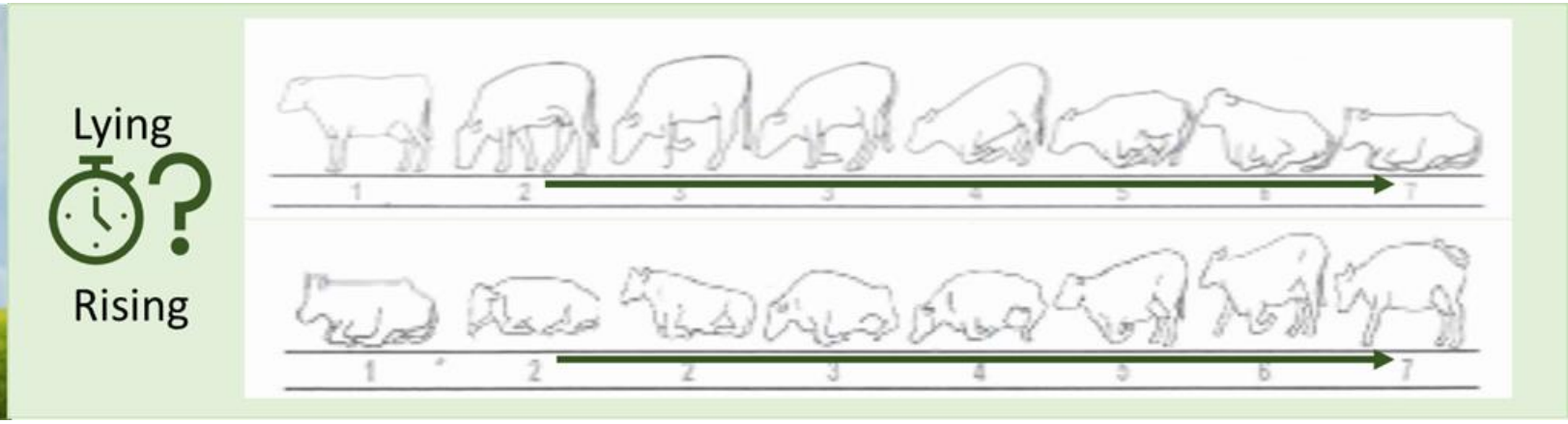
However...
Videos require further process
Tool is needed to annotate important event

Project
KB DDHT AI – Knowledge base of using AI
KB WLR SIP – Small Innovative Project



Introduction

Interest: behaviours, especially **welfare indicators**



Duration* of rising and lying

*The seconds it takes for an individual cow to complete from event 2 to 7

Research Goal

Develop knowledge and skills to analyze, interpret and extract desired information from videos and images

- Track all animals in the view
- Identify behavioral events when they occur, with special focus on the duration of lying down and getting up
- Summarize all the events

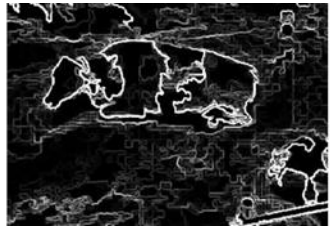
ID	Events	Duration	...
12	stand	30 mins	
08	walk	3 mins	

Challenges

Compromising view of animals

⇒Segmentation & object detection

Cows are difficult to tell from the gray background



Challenges

Lack of behavioral quantifier

Movements are difficult to define

⇒Region-based CNN: object detection + behavioral classification

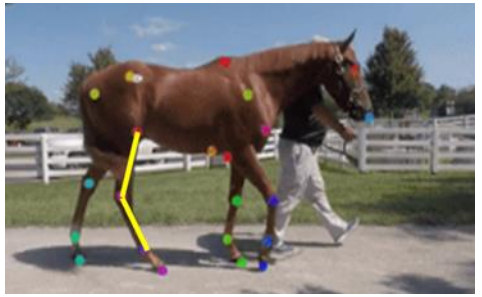
Unbalanced class – standing up is short

Misclassification – part of cow is recognized as a whole cow

⇒DeepLabCut: Skeleton for animals – joints & limbs

Skeleton for cows was not available

Generate large amount of data + long time training



Methods

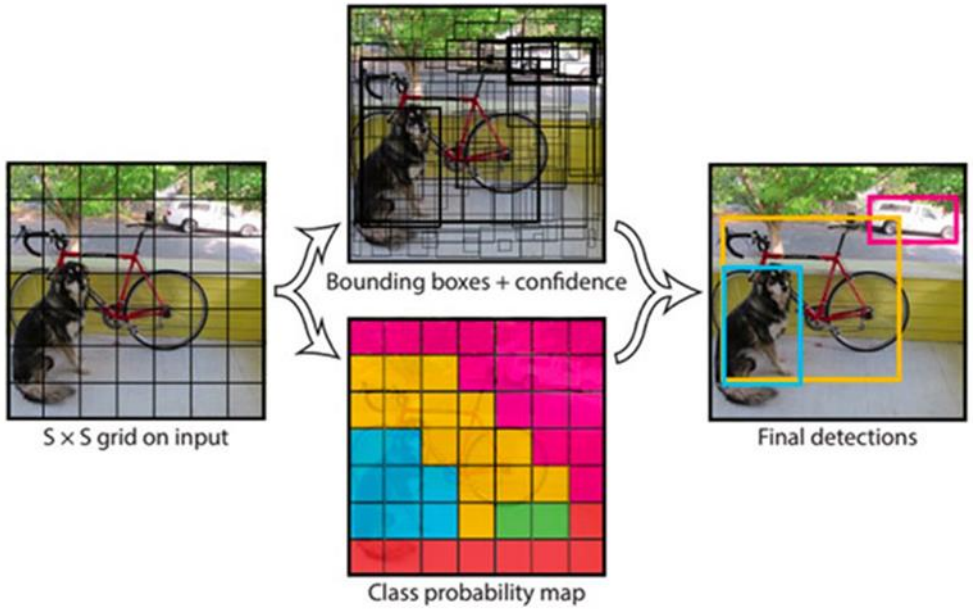
Track all animals in the view => **Tracker**

Identify behavioral events when they occur, with special focus on the duration of lying down and getting up => **Quantifier**

Summarize all the events => **Output**

Tracker

Identify all the animals within the view

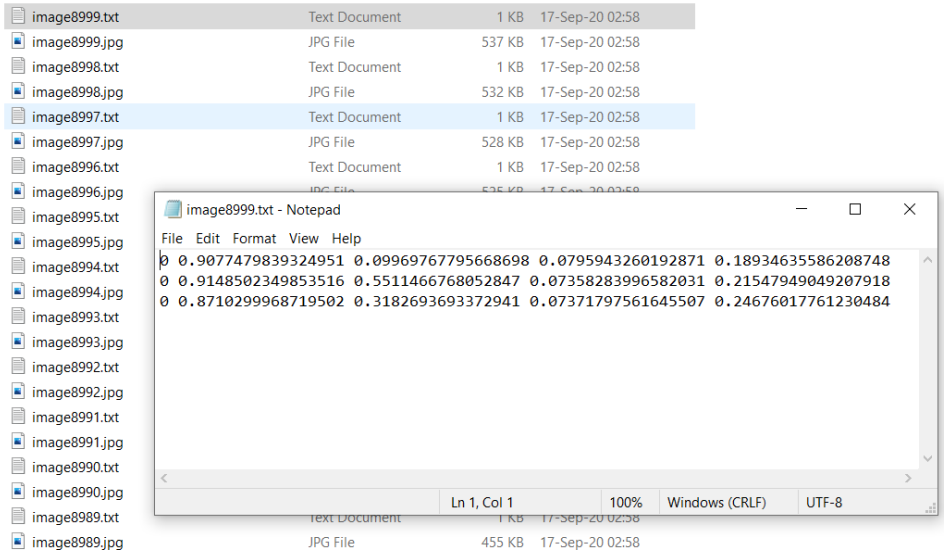


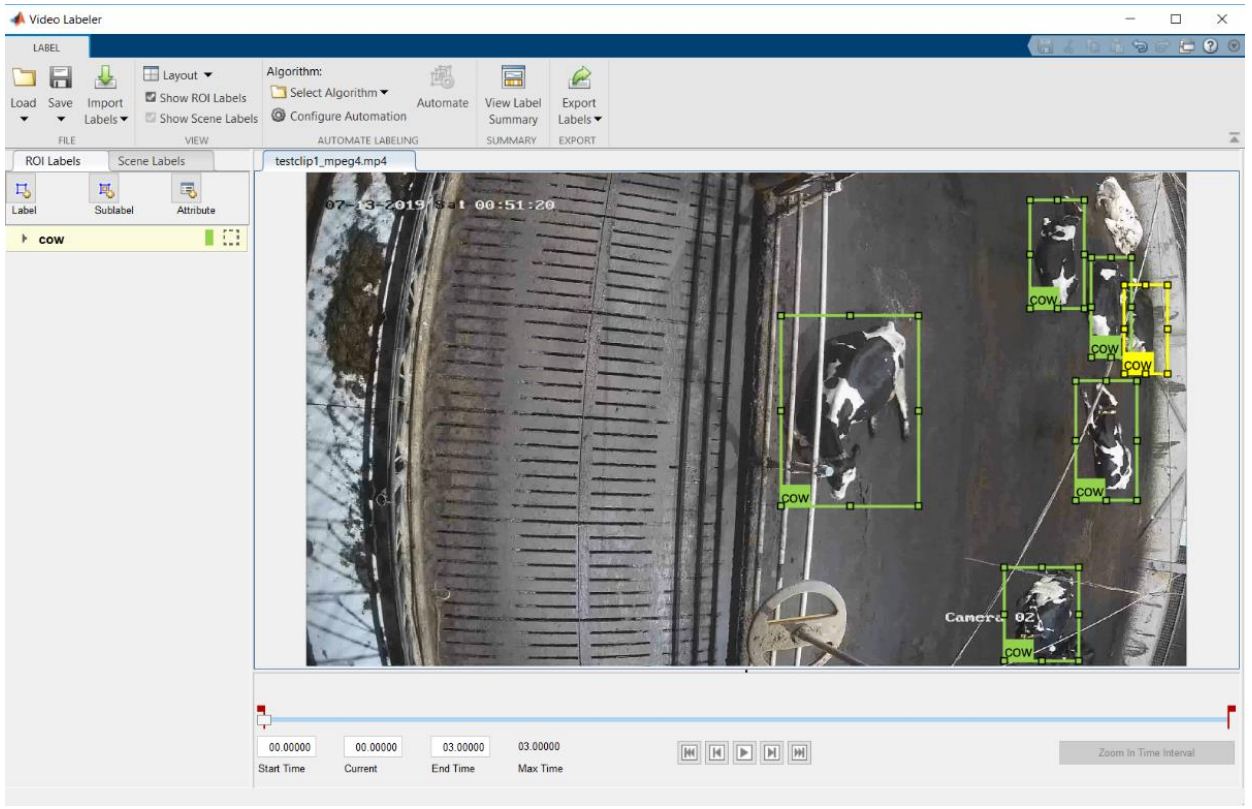
YOLO – You Only Look Once

- Single neural network applied to the full image
- Divides the image into regions
- Predicts bounding boxes and probabilities for each region
- These bounding boxes are weighted by the predicted probabilities

Tracker - YOLO

- MATLAB – VideoLabeler using bounding box
- Convert into YOLO format - <object><x><y><width><height>





Tracker - YOLO

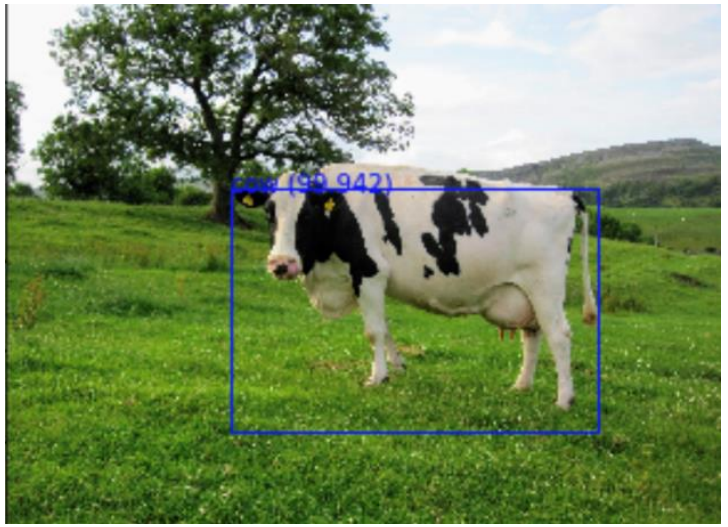
- Pre-trained YOLO

CANNOT recognize cows in barn

Can recognize cow in general

- Train our own YOLO

```
image7728 0.995508 2145.502441 308.508362 2380.459961 665.646179
image7728 0.993132 2253.451416 640.792419 2432.932861 952.155090
image7728 0.991548 2215.726807 10.856537 2432.254150 289.911621
image8901 0.991162 2257.221924 637.114807 2429.729248 960.085632
image8901 0.988942 2209.823730 1.000000 2431.069824 293.819641
image8901 0.965071 2128.835693 315.192017 2333.830811 608.988159
image1822 0.991633 2247.848145 632.984375 2438.109863 957.166260
image1822 0.990034 2215.454102 11.175034 2439.655762 269.157471
```



Tracker – Result

- More than 75% of confidence

```
Enter Image Path: /home/WUR/xue014/darknet/data/images/image1822.jpg: Predicted in 0.024474 seconds.
cow: 100%
cow: 99%
cow: 99%
Enter Image Path: /home/WUR/xue014/darknet/data/images/image5239.jpg: Predicted in 0.024359 seconds.
cow: 100%
cow: 99%
cow: 85%
```

- Cannot generate the confusion matrix
- Log file – Compile YOLO on HPC

  YOLO for everyone!
- Continue – KB DDHT AI

Methods

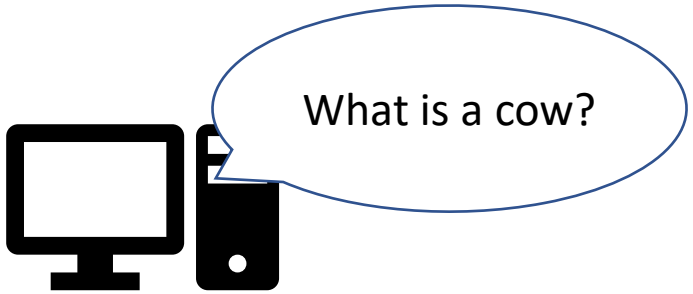
Track all animals in the view => **Tracker**

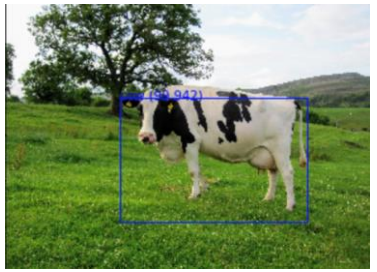
Identify behavioral events when they occur, with special focus on the duration of lying down and getting up => **Quantifier**

Summarize all the events => **Output**

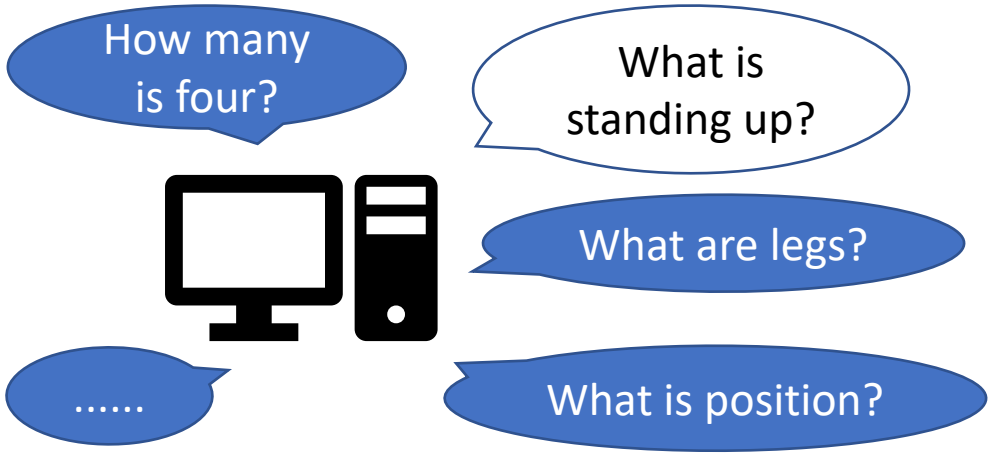
Quantifier

- Ask the computer to find a cow:





- Ask the computer to find certain behaviour – standing up:



Quantifier

	Object (Animal)	Behaviours
Traditionally	Annotation by eye on video	Annotation by eye **on video**
In this project	Annotation by eye on video	Annotation on **video properties**

Content-Based Image Retrieval (CBIR) system

- Retrieve similar images from a large database
- Content: colors, shapes, textures, or any other information
- Translate behaviors into more computer friendly information

Quantifier

Similarity between frames with focus on Region of Interest (YOLO bounding box)

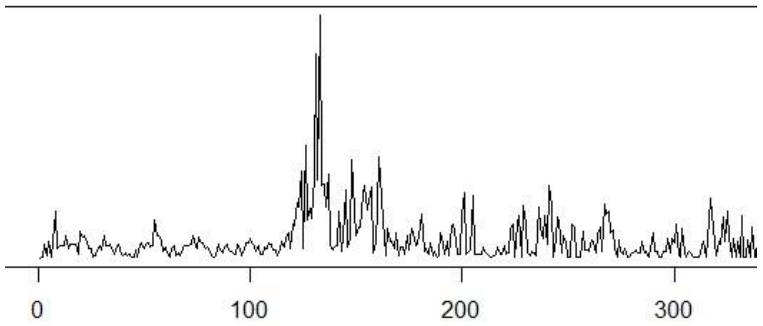
Frame *N*

Standardization
Convert each ROI into a vector
Calculate the Manhattan distance

Frame *N+1*

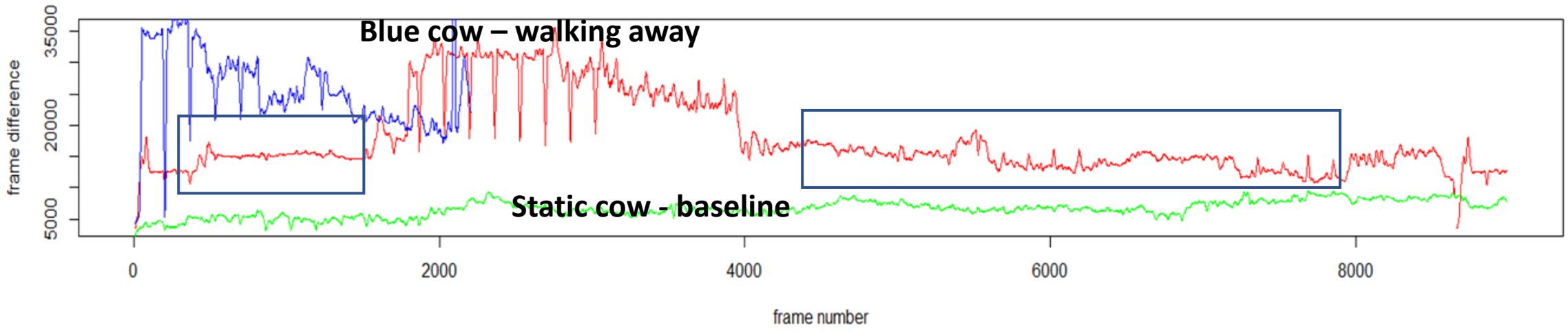
Video

Result



For lying down and getting up

- Two peaks are formed due to cows movement
- Duration is represented by the distance between two peaks
  - In 37% of the test sample, the detected duration has a difference of 1 sec with the actual duration



Discussion

Test YOLO on more material with similar background

Difference (similarity) in consecutive ROIs can be used as behavioral indicators or quantifier

- Need smoothing or other preprocessing
- Annotation: assign more patterns to certain behavioral events
- Further learning/thresholding to recognize patterns

Track animals longer, generate behavioral profile

Acknowledgement

Contact Person

Claudia Kamphuis

Wijbrand Ouweltjes

Ina Hulsegge

Special Thanks also to

Roel Veerkamp

Yvette de Haas

Esther Ellen

Jochen Hemming

Janne Kool

Jan Erik Doornweerd

Thanks for listening

Have a very nice day