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ANIMAL WELFARE INDICATORS AT THE SLAUGHTERHOUSE

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# Automated tear staining detection in pigs at slaughter

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ILVO Flanders Research Institute for Agriculture, Fisheries and Food

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# Tear staining background

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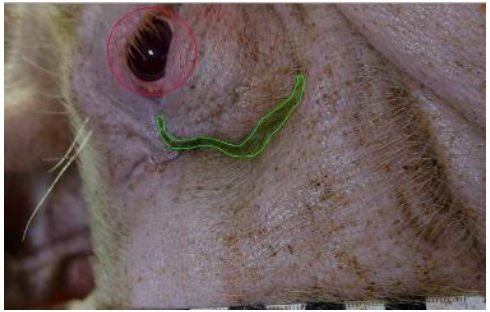
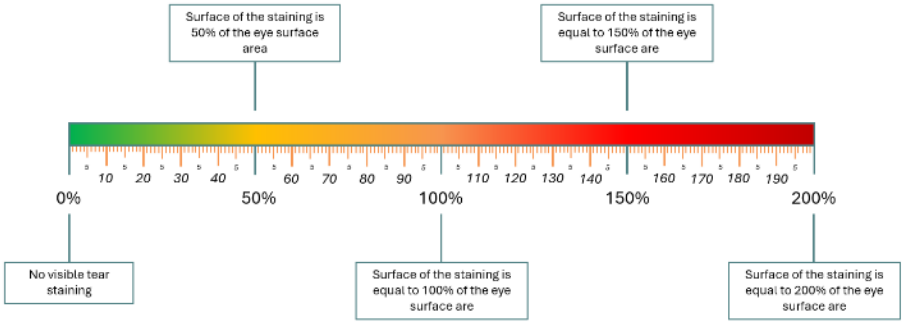
**Tear staining (TS):**

- Brown-yellow stain (Excretion of harderian gland)
- Stress response
- Novel welfare indicator

**Interpretation of TS:**

- Ratio of stain size versus eye surface
- Human assessor (visual or manual annotation)



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# TS assessment: Challenges

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**TS evaluation is difficult:**

- Time-intensive
- Limited inter- and intra annotator consistency:
  - Difficult to outline the staining
  - Obscured due to hair/faeces/skin colour

**To be applicable as welfare indicator:**

- Efficient/scalable
- Reliable

**Proposed solution: Automated detection system at the slaughterhouse**

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# Experimental setup

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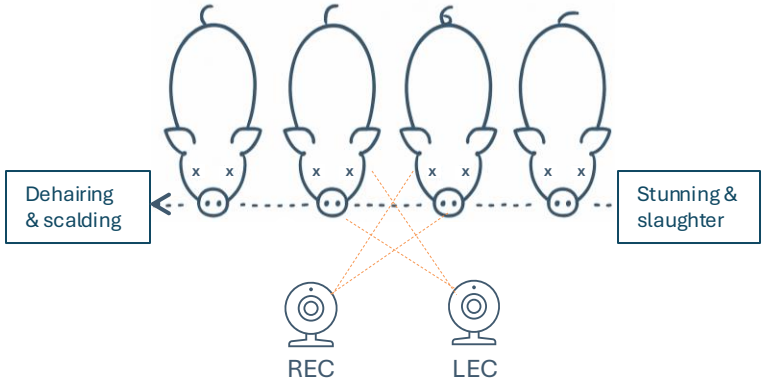
**Hardware setup**

- 2 RGB-camera setup
- Bleeding line
- Guiding system to standardise orientation

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# Approach

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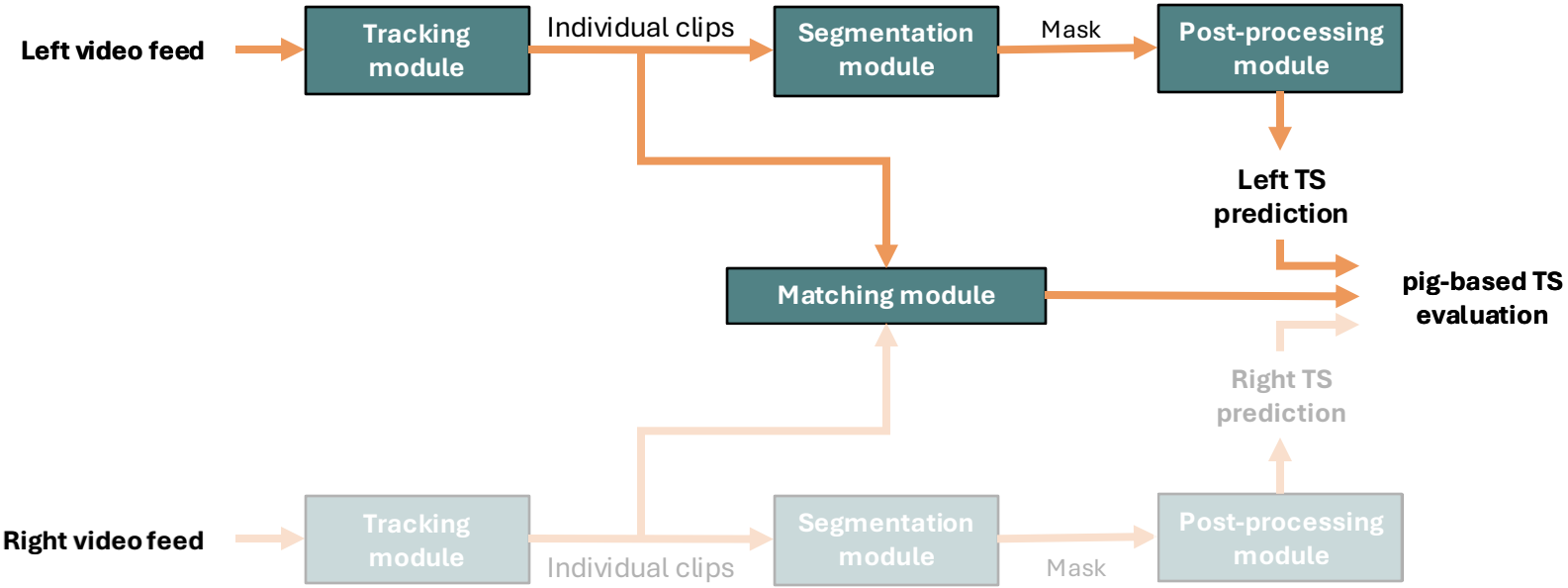
**Algorithm-centric approach:**

- 4 main modules
- Symmetrical

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# Module 1: Tracking individual pigs

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**Detection & tracking models**

- Bounding box (eyes-nose region)
- Yolov11n + ByteTrack
- 2000 images


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# Module 2: Detecting tear staining

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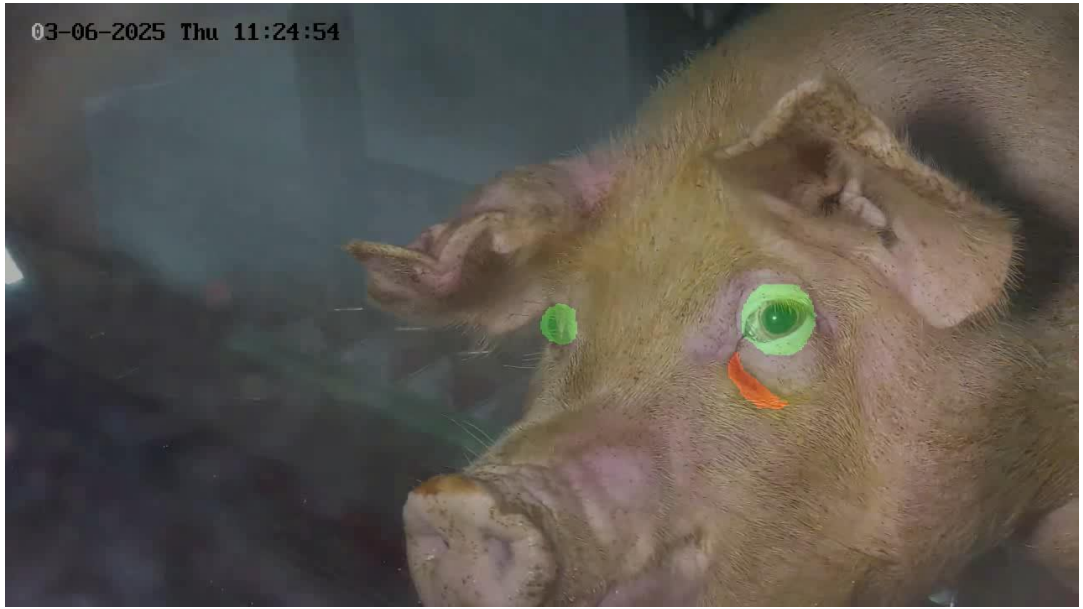
**Segmentation model**

- Tear staining & eye regions
- nnUNet
- 1000 images

Heuristic rules?
➔If 2 eyes, left = right eye and right = left eye
➔Assign (largest) TS to closest eye

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# Module 2: Detecting tear staining

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# Module 2: Detecting tear staining

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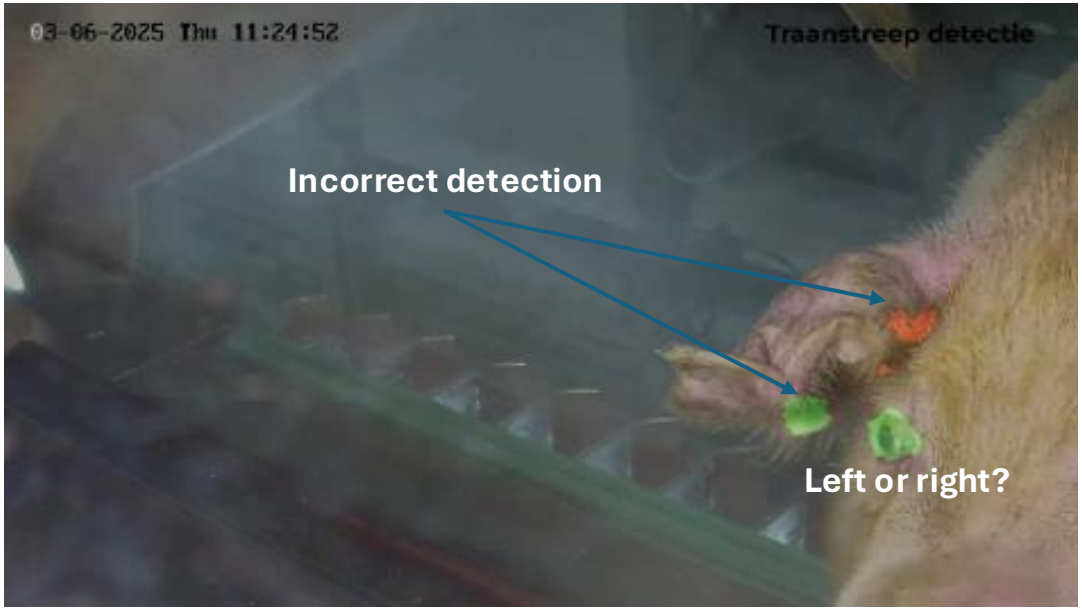


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# Module 3: Post-processing

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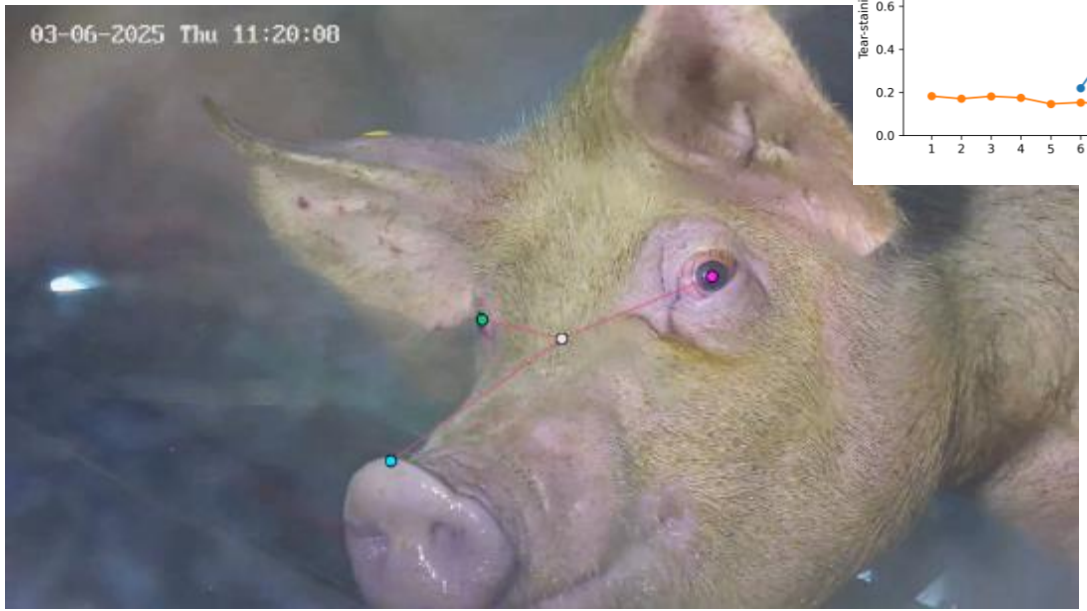
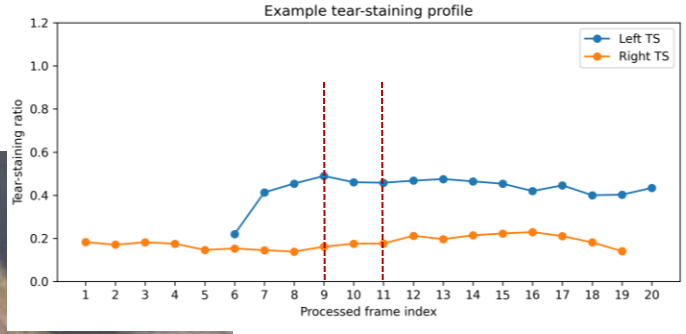
**Pose-estimation model**

- 4 keypoints: left eye, right eye, nose, front head
- Yolov11s
- 1000 images

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# Module 4: Linking video feeds

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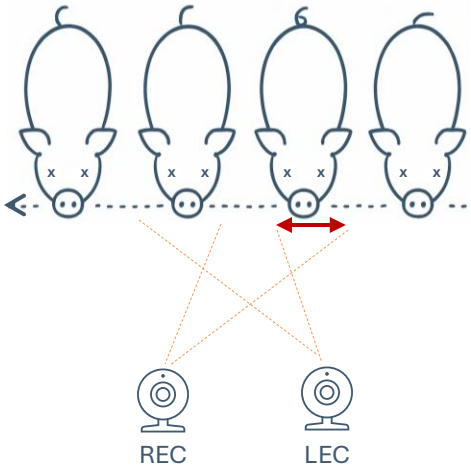
**Temporal matching:**

- OCR model reads frame time
  ⇒ Each clip corresponds to a time window

- Hungarian matching algorithm (entry delay)





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# Preliminary performance

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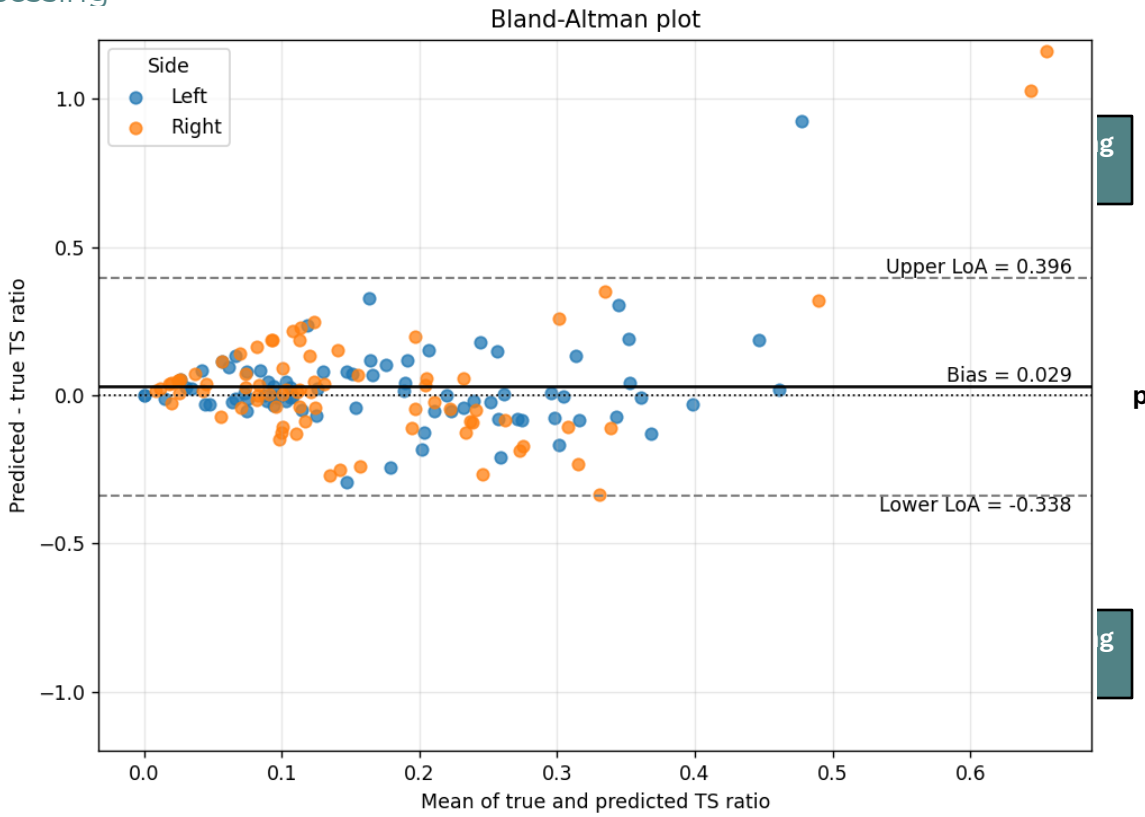
**10 min recording (≈80 pigs)**

- 60 min of processing

**10 min video**

**10 min video**




**pig-based TS evaluation**

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# Challenges and conclusion

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## Sources of difficulties

1. **Slaughterhouse conditions:**
   - Blood & water accumulation on protective panel (cleaning)
   - Standardised lighting conditions
   - Space requirement
2. **Animal characteristics:**
   - Body morphology (size, ears)
   - Skin colour, fur, faeces, blood
3. **Algorithm**:
   - Errors compound
   - Slow processing speed


**Still automated tear staining at slaughter is viable**

- Low hardware requirements
- Detect tear staining consistently

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# Thanks for your attention

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