VLAIO TETRA

Machine Vision for Quality Control

(MV4QC)

Case 3

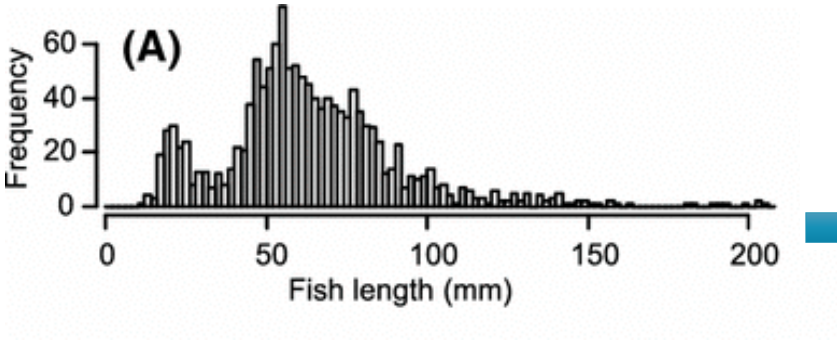
Inline determination of the length distribution of fish by category

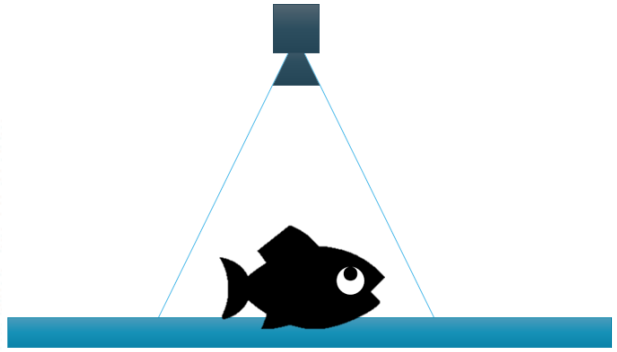
ILVO

Met de steun van VLAIO

Objectives

- Instituut voor Landbouw-, Visserij- en Voedingsonderzoek
- Ecological project
- Objectives
  - Detection
  - Classification
  - Length determination

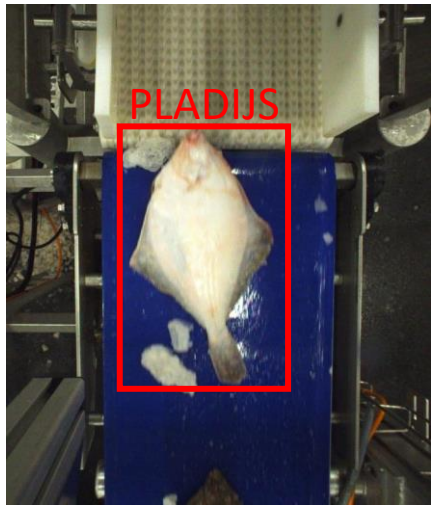


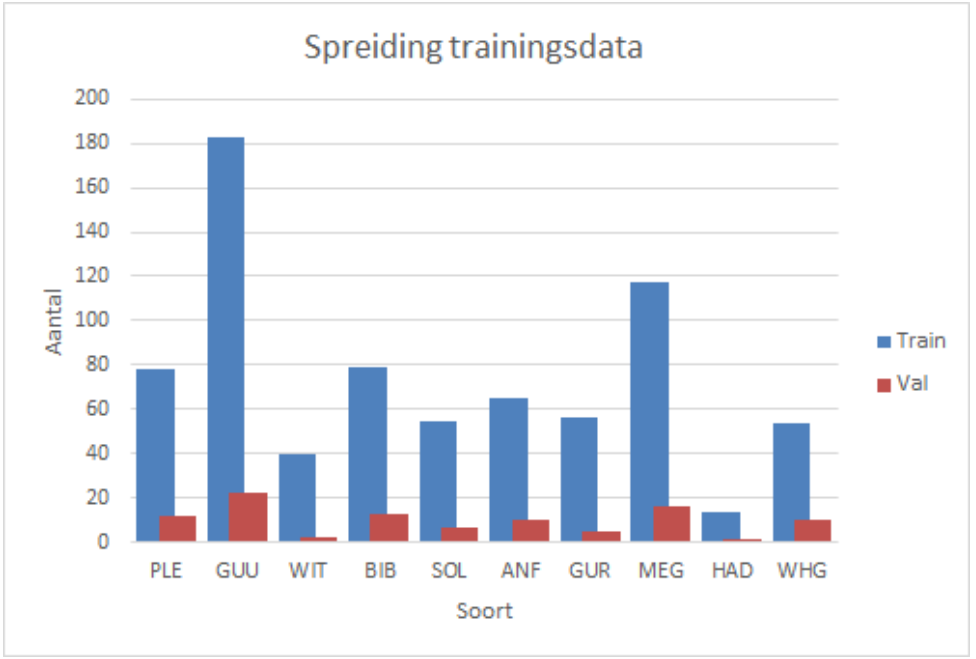


Dataset

Dataset containing:

- 18 videos
- 5-10 min
- 10 species





LabelBox render:

- Image url
- Bounding box [left, top, width, height]
- Class [PLE,GUU,WIT,BIB,SOL,ANF,GUR,MEG,HAD,WHG]

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Hardware setup

- Camera: MER2-302-56U3C
  - USB3.0
  - C-mount
  - 2048x1536 (3MP)

- Lens: LCM-5MP-04MM-F2.0-1.8-ND1
  - Focal distance 4mm → wide angle
  - Aperture F2.0

- Illumination: TL-illumination from environment

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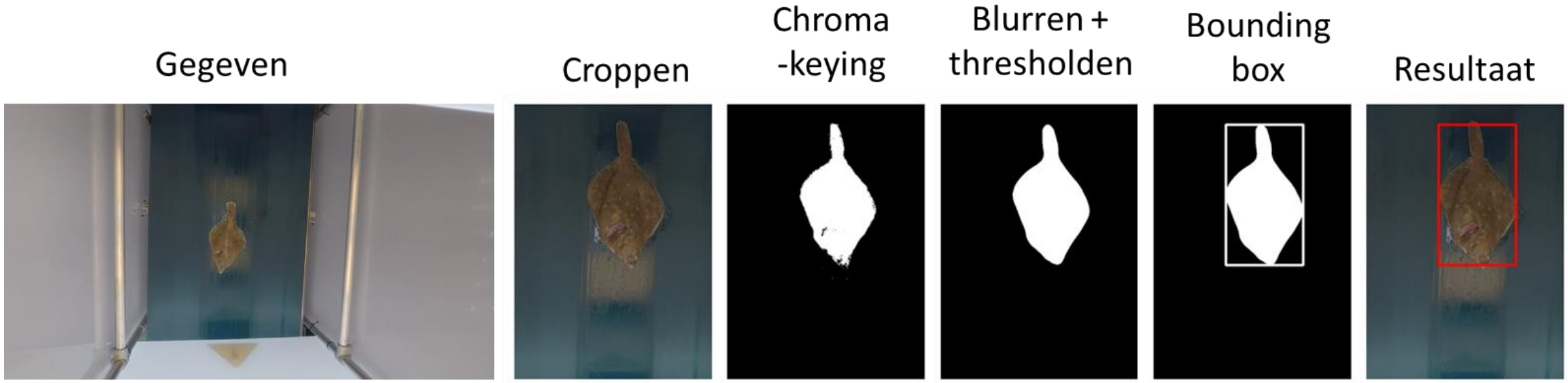
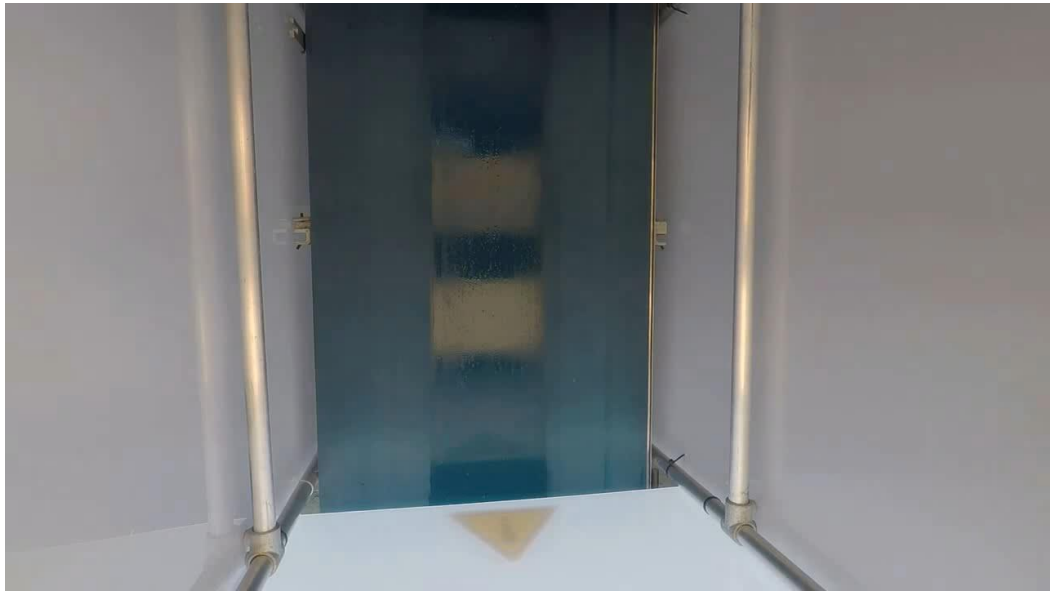
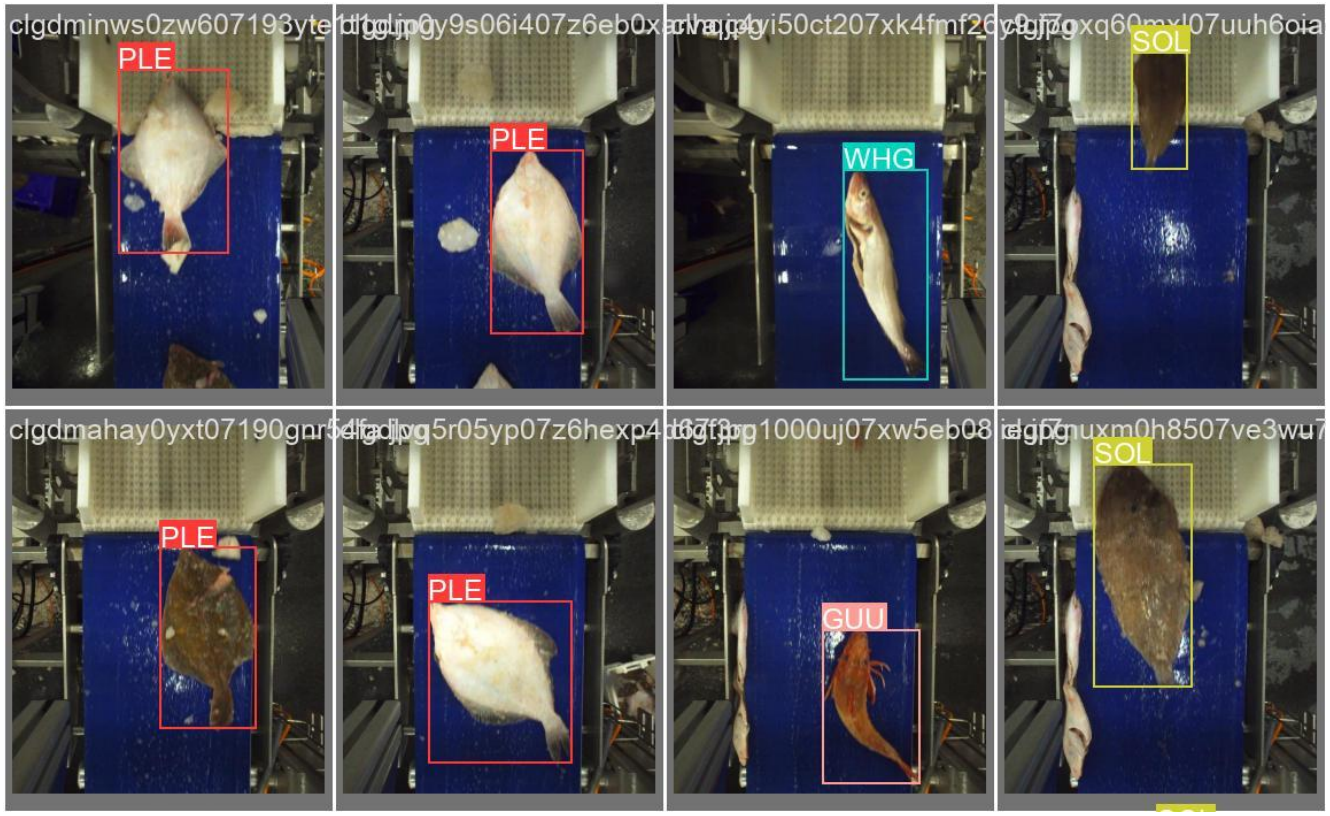
Image processing



Met de steun van VLAIO

Object detection and classification - YOLO





Met de steun van VLAIO

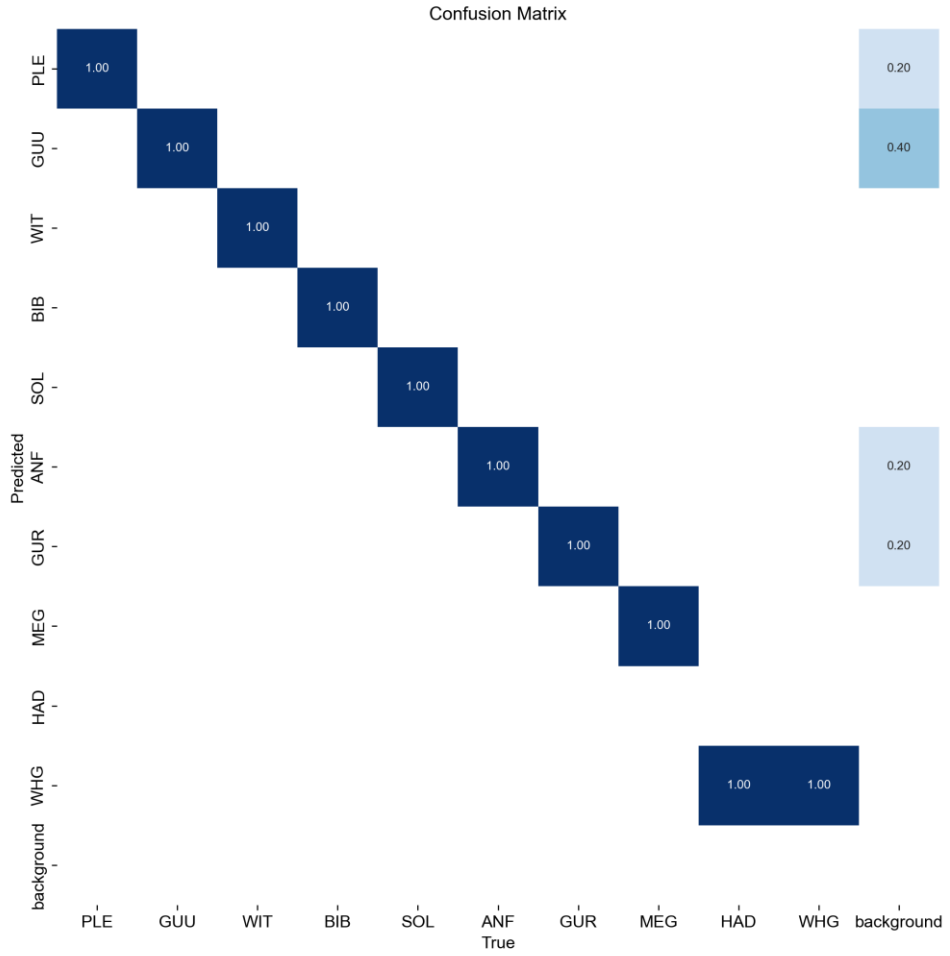
Object detection and classification - YOLO

- HAD systematically detected as WHG

  → Very few images of HAD

  → HAD and WHG are similar

- Background not correctly classified

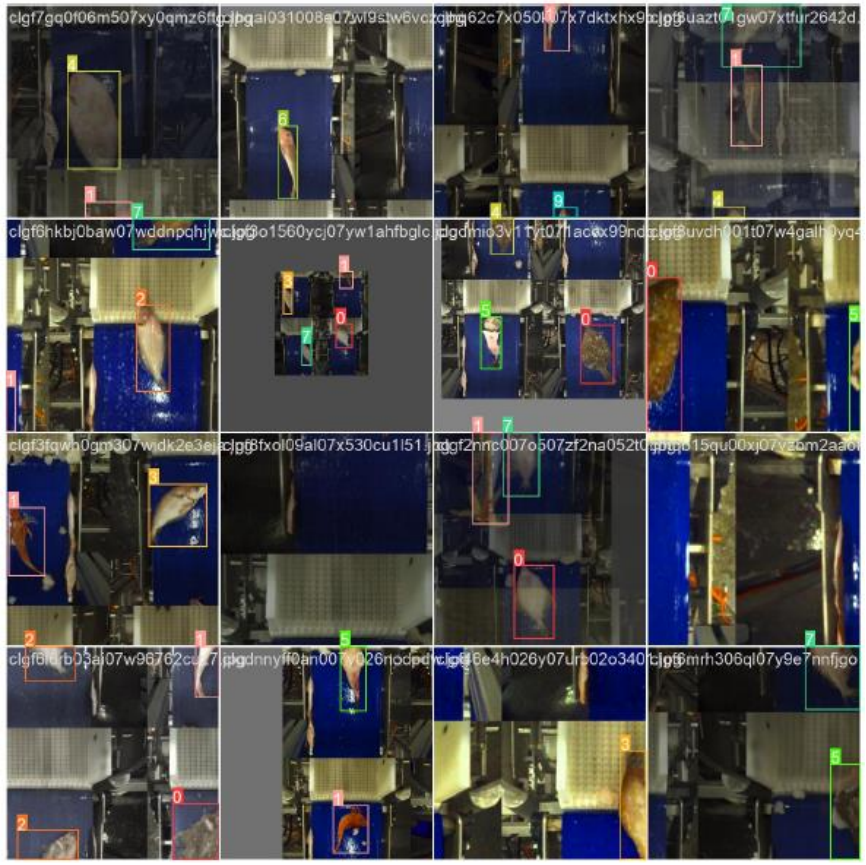


Met de steun van VLAIO

Object detection and classification - YOLO

Improvements:

- Imbalanced dataset techniques
  - Oversampling
  - Weighting error
- Data augmentation
  - Brightness, scale, rotation, etc.



Met de steun van VLAIO

Object detection and classification - Resnet

Model validation

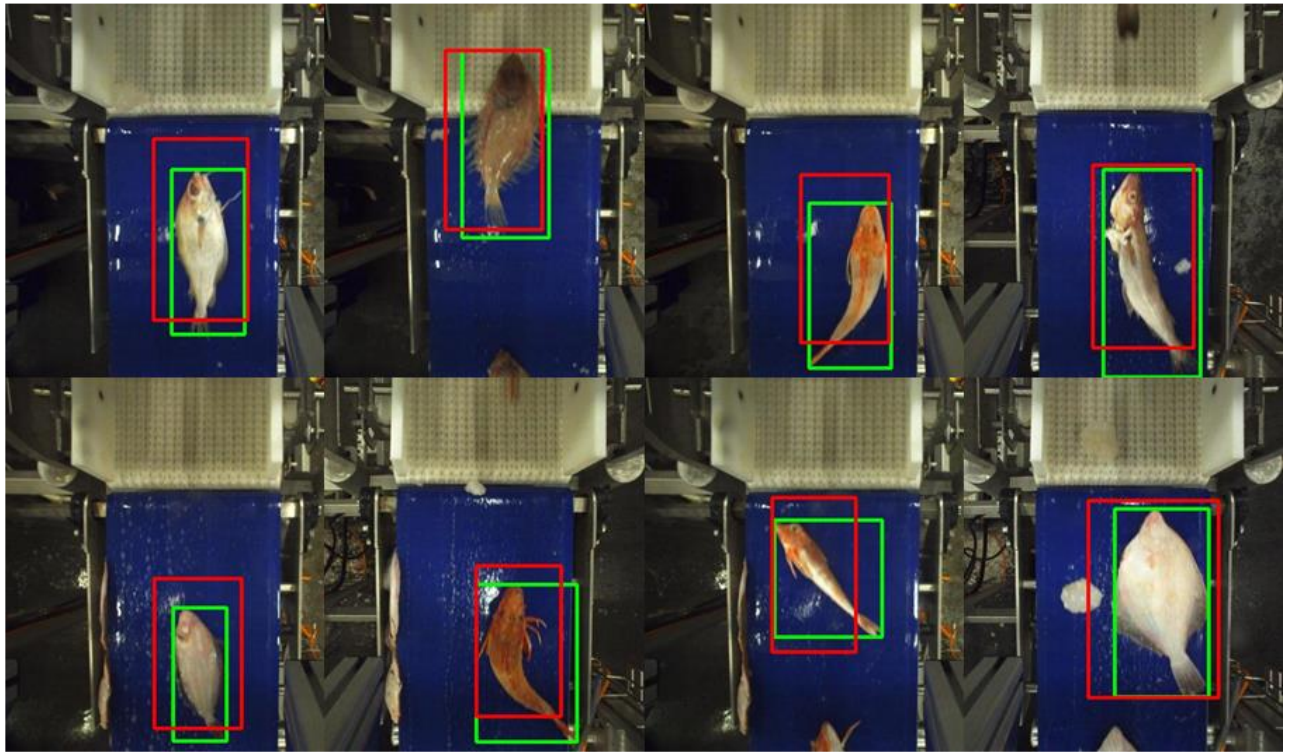
- Model: ResNet18 pretrained
- Input:
  - 500x500 pixels
  - Normalized
- Hyperparameters:
  - Epochs: 100
  - Learning rate: 0.0005
  - Batch size: 16

		BestHD1									
		Werkelijke soort									
		PLE	GUU	WIT	BIB	SOL	ANF	GUR	MEG	HAD	WHG
Voorspelde soort	PLE	12	0	0	0	0	0	0	0	0	0
	GUU	0	22	0	0	0	0	0	0	0	0
	WIT	0	0	2	0	0	0	0	0	0	0
	BIB	0	0	0	13	0	0	0	0	0	0
	SOL	0	0	0	0	7	0	0	0	0	0
	ANF	0	0	0	0	0	10	0	0	0	0
	GUR	0	0	0	0	0	0	5	0	0	0
	MEG	0	0	0	0	0	0	0	16	0	0
	HAD	0	0	0	0	0	0	0	0	1	0
	WHG	0	0	0	0	0	0	0	0	0	10

Met de steun van VLAIO

Object detection and classification - Resnet

- Tail sometimes not detected properly



Met de steun van VLAIO

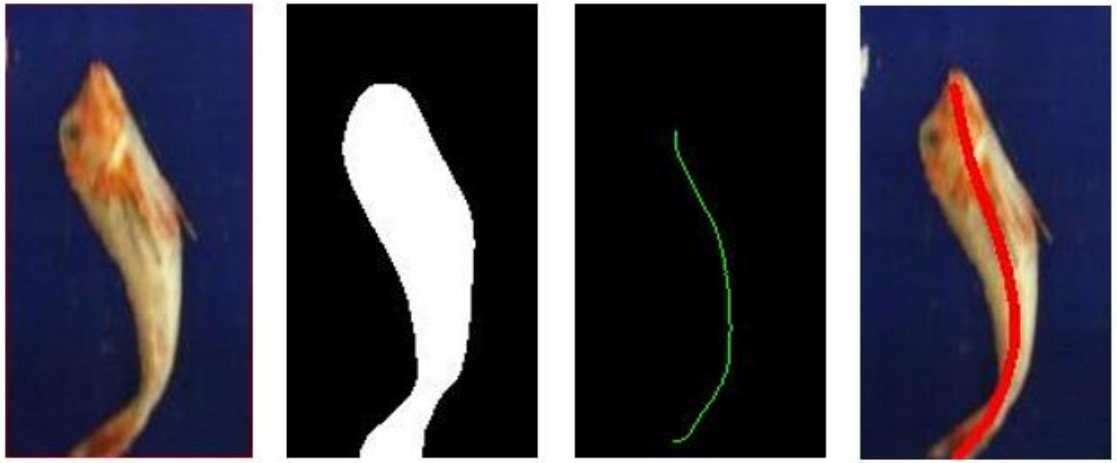
Length determination

1. Cropping using bounding box

2. Segment fish using
   Segment anything model (SAM)

3. Skeletonisation

4. Number of pixels → real length

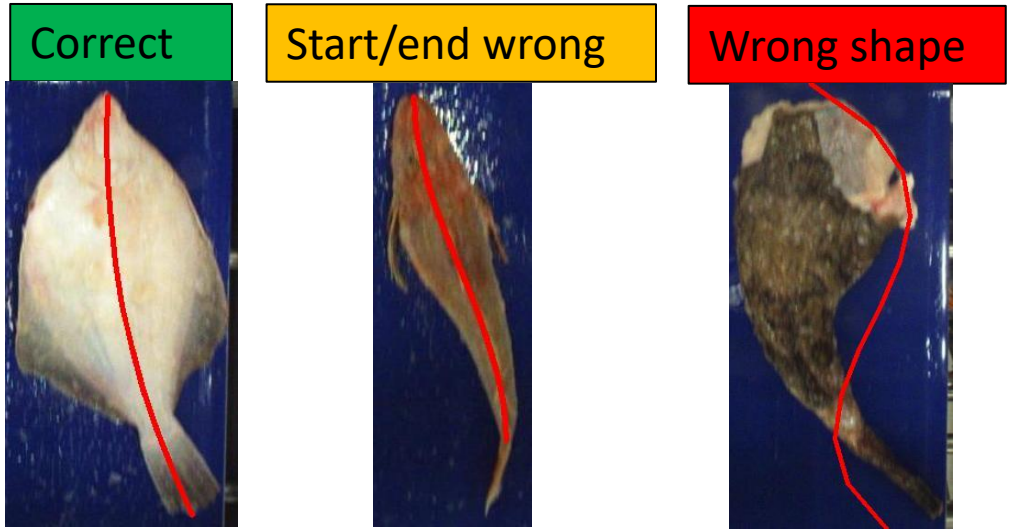


Met de steun van VLAIO

Length validation

- Visually (no length data)
- 11% due to SAM
- 9% fish not in middle
- 5% wrong mask

74%	Correct
11%	Start/end wrong
9%	Wrong shape
5%	Error

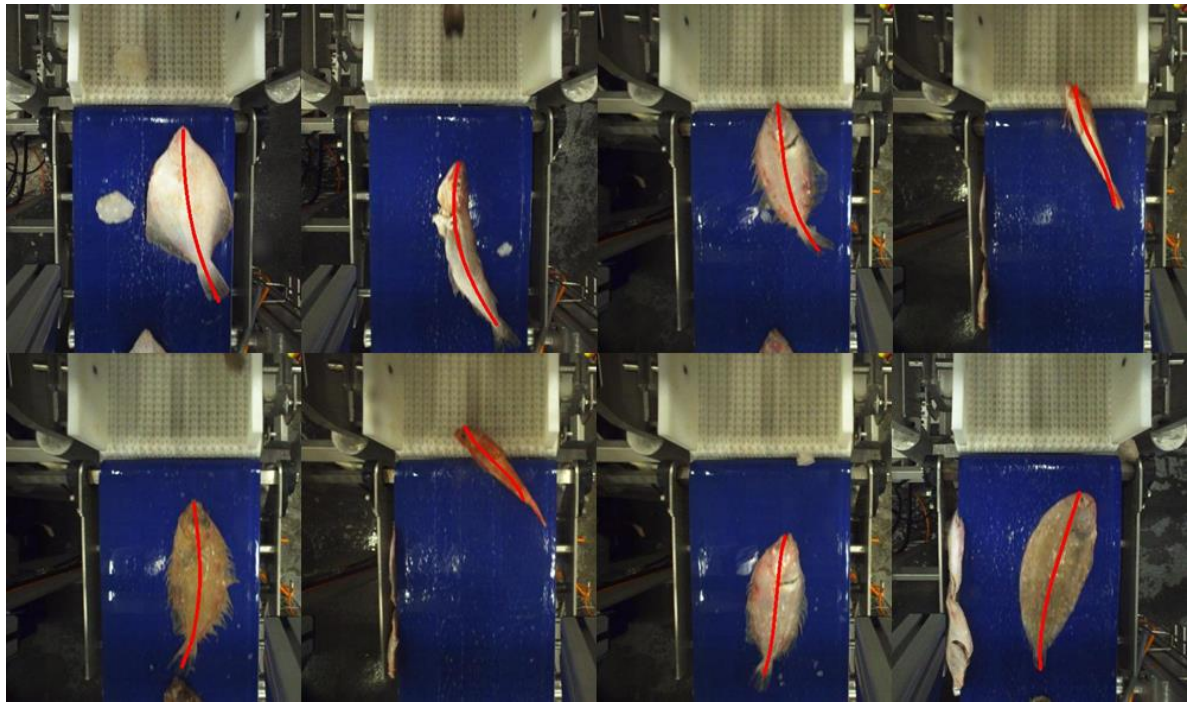


Met de steun van VLAIO

Totaal system validation

- 74% rating was based on images with correct bounding boxes
- 86% of the bounding boxes are correct
- 64% is the total succes rate of the system

64%	Correct
20%	Start/end wrong
14%	Wrong shape
1%	Error



Met de steun van VLAIO

Conclusions

- Larger and more balanced dataset → better results
- Larger image size → better results
- YOLO had difficulties in predicting HAD
- Tail is difficult for Resnet but no problem for YOLO
- YOLO provides an easier framework for performant model development
- SAM is time consuming and causes the largest errors

Met de steun van VLAIO