

A Novel Dataset and Deep Learning Object Detection Benchmark for Grapevine Pest Surveillance

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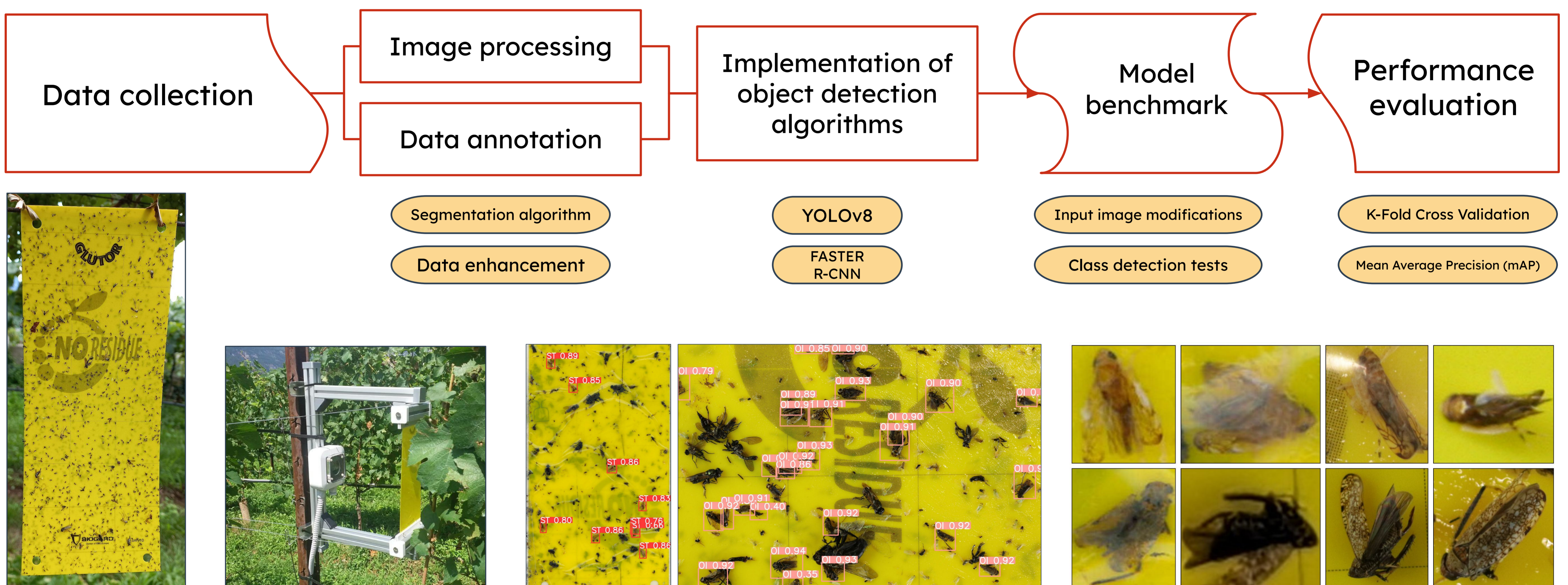
INTRODUCTION

- Flavescence dorée (FD) poses a significant threat to grapevine health, causing annual yield losses and high production costs due to uprooting and replanting.
- The American grapevine leafhopper, *Scaphoideus titanus*, is the primary vector of FD. Another potential vector is the morphologically similar mosaic leafhopper, *Orientus ishidae*.
- Current vector monitoring activities using yellow sticky traps are labour-intensive and time-consuming.
- There is a growing interest in applying computer vision for **insect detection**. However, the **lack of high-quality datasets** has hindered the development of automatic monitoring solutions.

OBJECTIVE

To develop a deep learning model capable of accurately identifying grapevine pests on yellow sticky traps, providing a reliable support tool for effective pest management and control in vineyards.

MATERIALS & METHODS



RESULTS & DISCUSSION

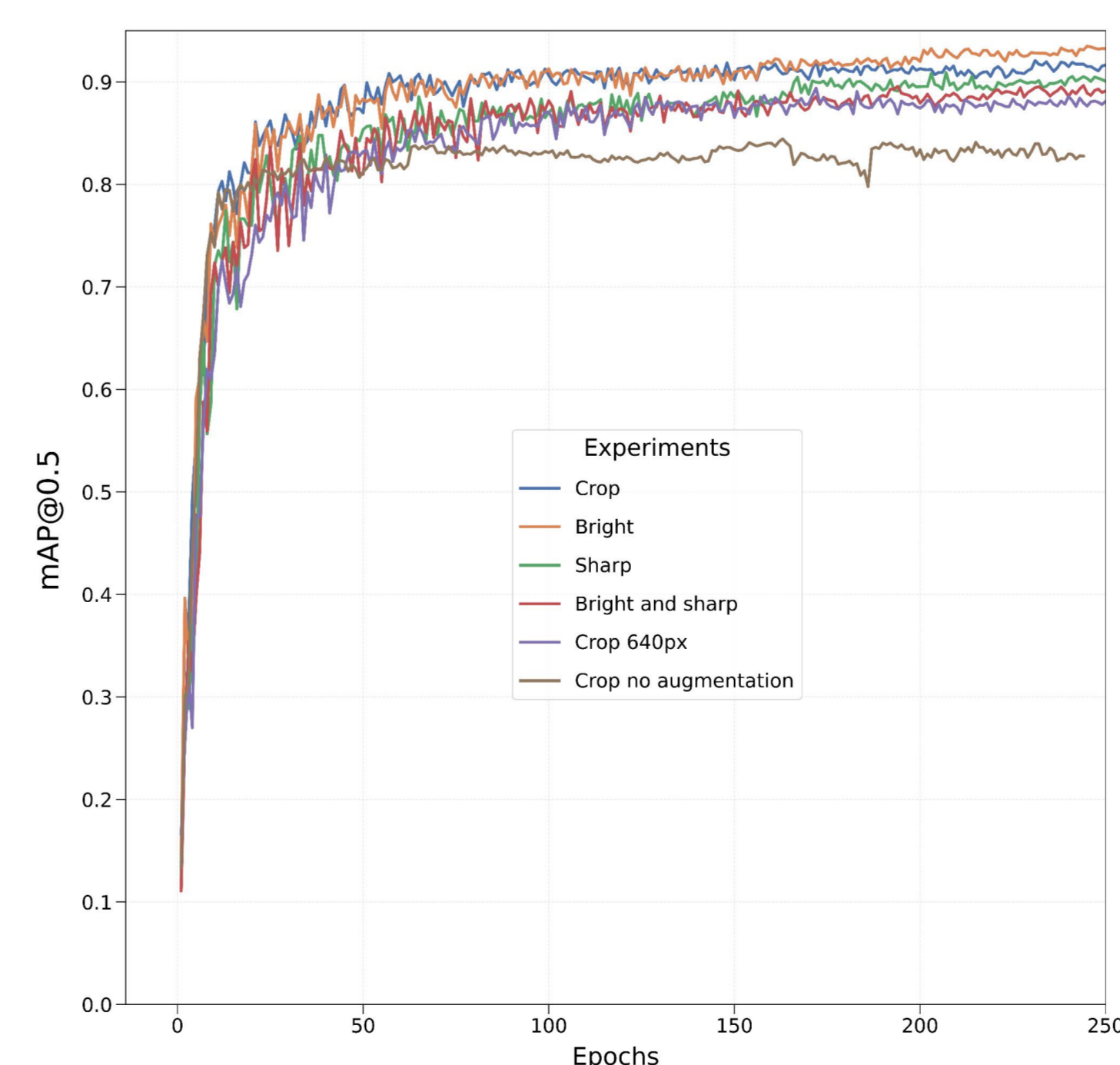
- Created and released a **fully annotated dataset** of over 600 yellow trap images, with approximately 1500 annotations per class for *S. titanus* and *O. ishidae*, serving as a reference for autonomous pest identification against FD.
- Demonstrated the effectiveness of object detection algorithms in identifying small insects on yellow sticky traps, despite acquisition challenges.
- Found that image processing techniques (brightness, contrast, sharpness) did not improve model performance with our dataset and potentially introduced noise.
- YOLOv8s** outperformed Faster R-CNN in accuracy and robustness, achieving a **mAP@0.5 of 92%**, an F1-score above 90%, and a mAP@[0.5:0.95] of 66%.
- This benchmark offers encouraging prospects for developing more effective strategies in the fight against Flavescence dorée.

| Image source | Number of images | ST annotations | OI annotations | Background images |
|--------------------|------------------|----------------|----------------|-------------------|
| Field | 18 | 3 | 101 | 8 |
| Laboratory scanned | 157 | 473 | 863 | 8 |
| Smart trap | 390 | 853 | 542 | 84 |
| Smart trap | 50 | 0 | 0 | 50 |
| TOTAL | 615 | 1329 | 1506 | 150 |

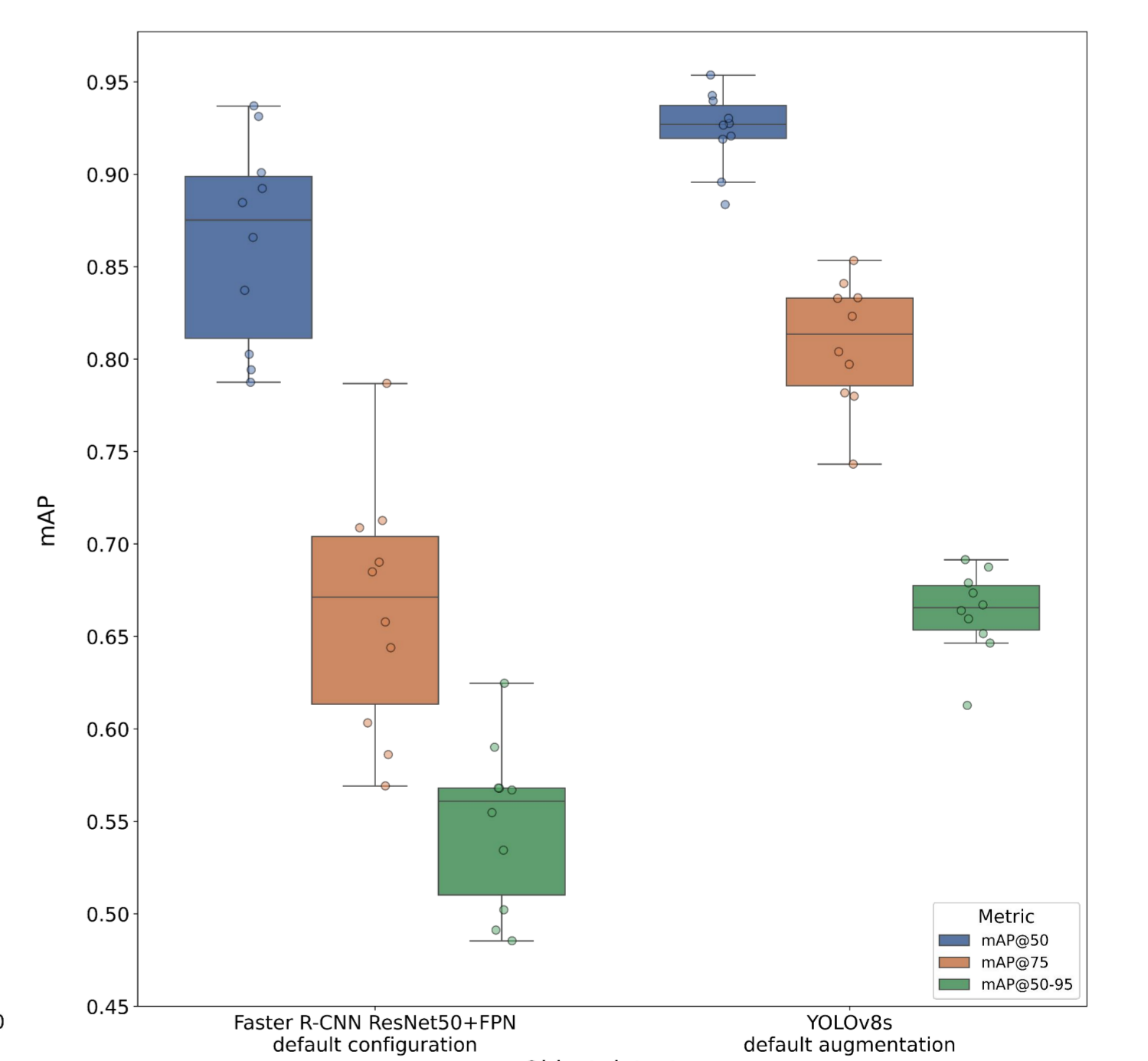
Dataset available on [Zenodo.org](https://zenodo.org)



Average curves of mAP@0.5 with epochs considering data enhancements, resolution and augmentation tests with YOLOv8s



Comparison of mAP@0.5, mAP@0.75, and mAP@[0.5:0.95] values between the optimal configuration of Faster R-CNN and YOLOv8s



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