

Output Monitoring for Object Detector

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Motivation

The box-wise objectness score for object detectors tends to be overconfident and sometimes in accurate. A published box may be tight on a object – or a poorly localized ghost. We present a lightweight monitor that, for every published bounding box, predicts its localization quality – the IoU it would have with the true object box – without access to ground truth. We apply the method on a FCOS3D pedestrian detector pretrained on ZoD dataset, to estimate the prediction quality and reliability and identify FP (false-positive) detections.



Figure 1: The FCOS3D pedestrian detector outputs high confidence score for two cyclists (© 2022 Zenseact AB*)

Overview

This work is inspired by MetaDetect[1]. We treat the detector as a black box. From ist output box statistics alone (scores, box geometry, the cluster of candidate boxes, etc.), learn to regress the unknown 2D IoU of each surviving box. The monitor has two outputs for each detected bounding box that is accepted according to a score threshold:

- A calibrated per-box IoU $\in [0,1]$.
- False positive flag (IoU < threshold).

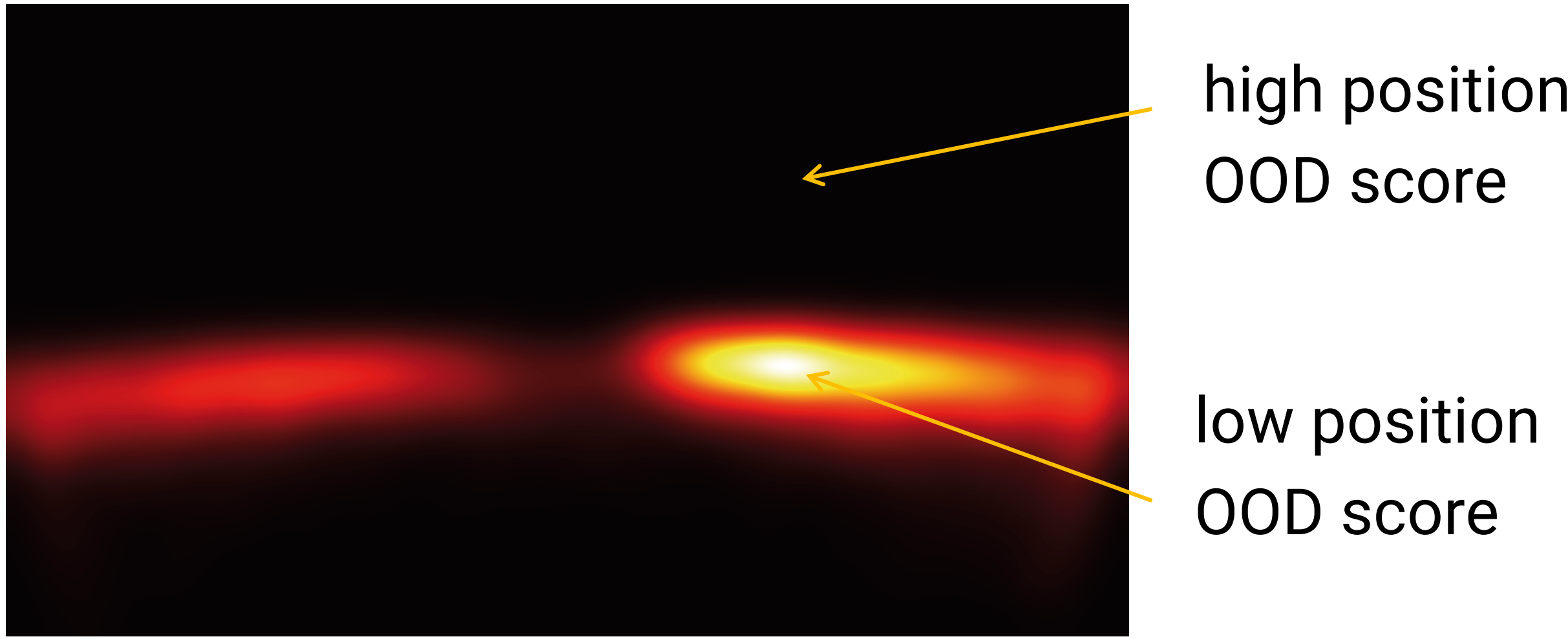


Figure 2: feature: position OOD (out-of-distribution) score

Evaluation Results

We use the same train/val/eval splits of ZoD

dataset as is used to train the FCOS3D detection model, to train the output monitoring model. And we get the following results:

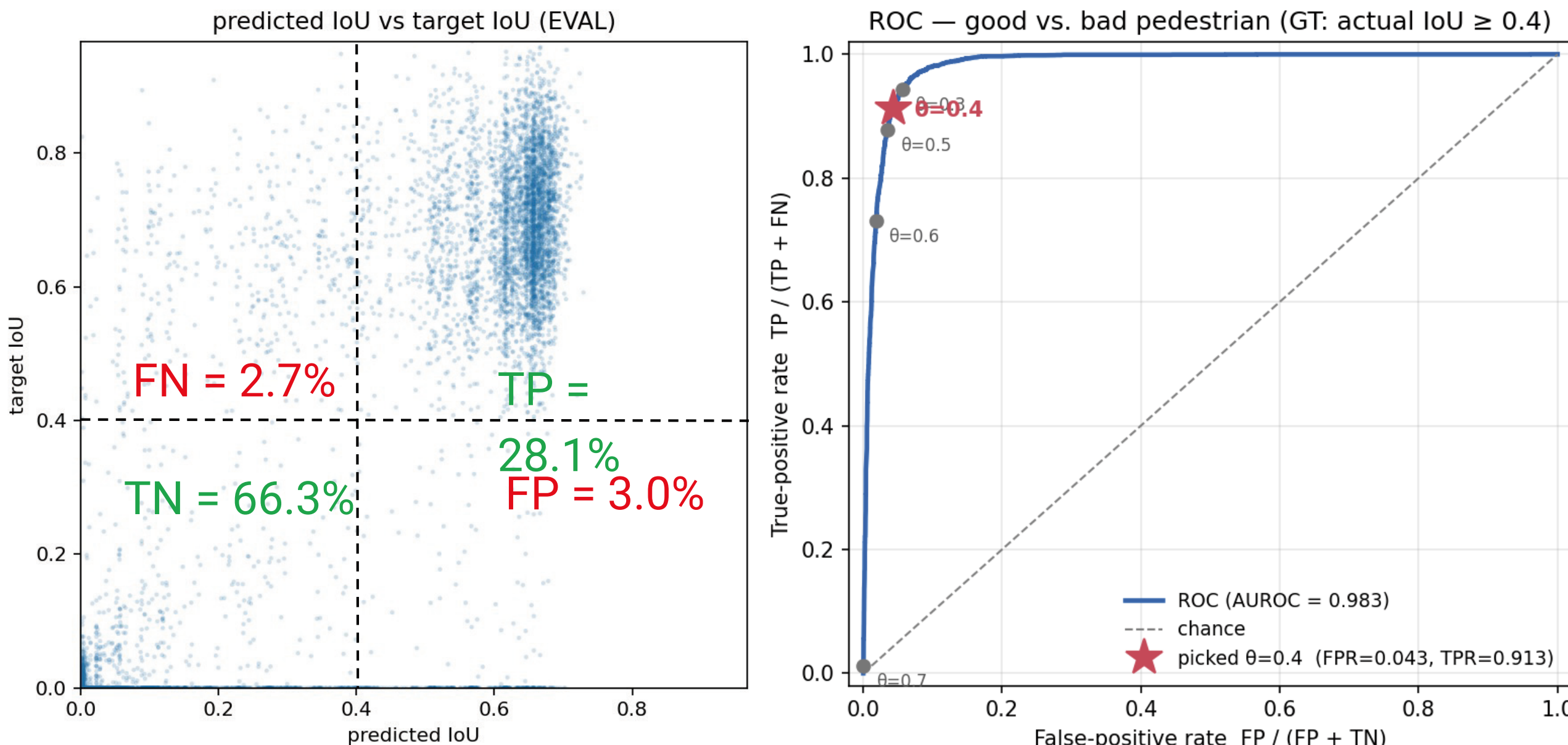


Figure 4: Left: predicted IoU vs. ground-truth IoU on evaluation set. Right: ROC curve of the monitor.

- Precision 0.904, Recall 0.913, F1 0.908, Accuracy 0.943.

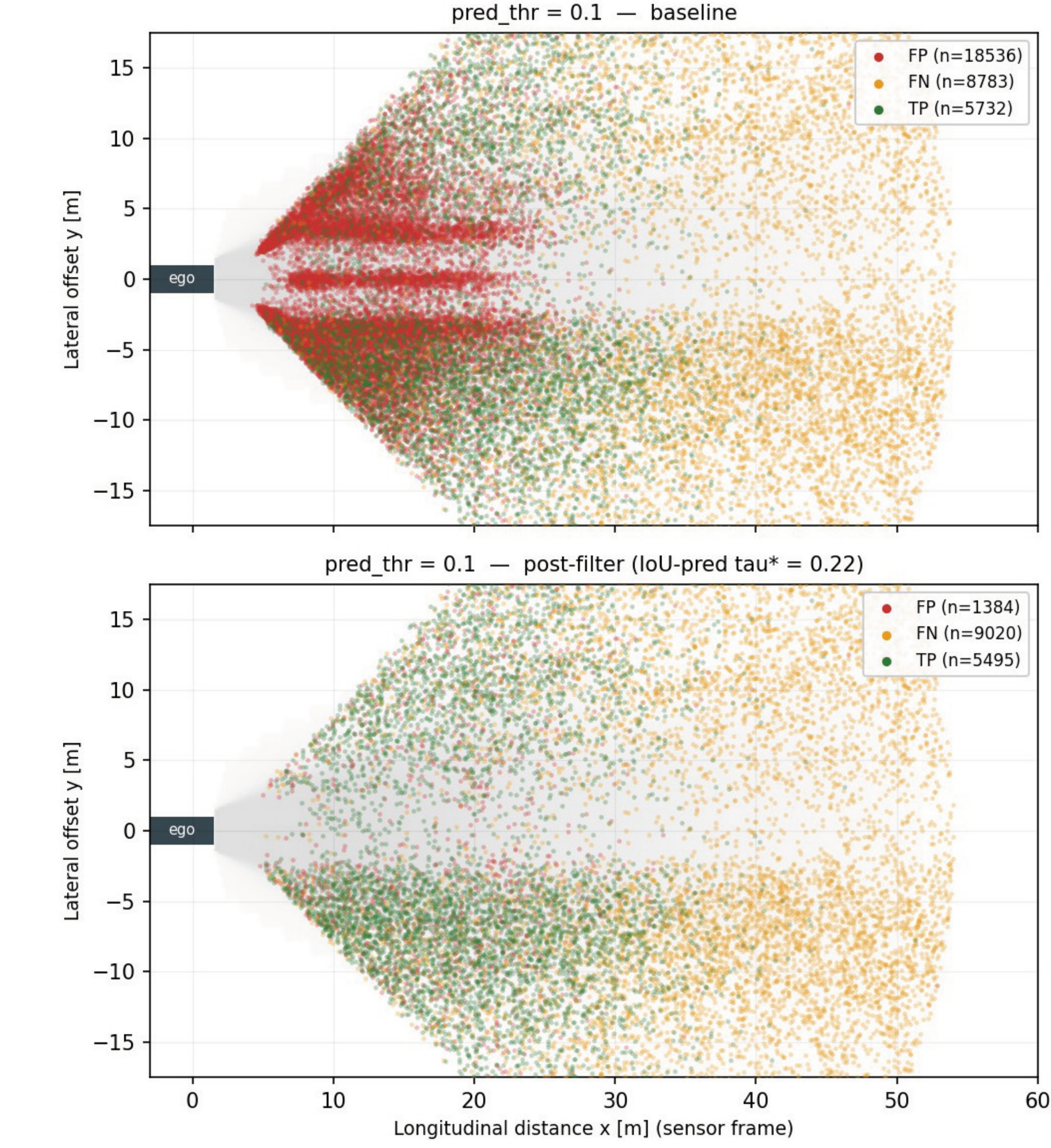


Figure 5: Identification of non-pedestrian FPs on evaluation set (© 2022 Zenseact AB*)

References:

[1] Schubert, et al., "MetaDetect: Uncertainty Quantification and Prediction Quality Estimates for Object Detection," 2020, arXiv:2010.01695.

Detection Output Monitoring

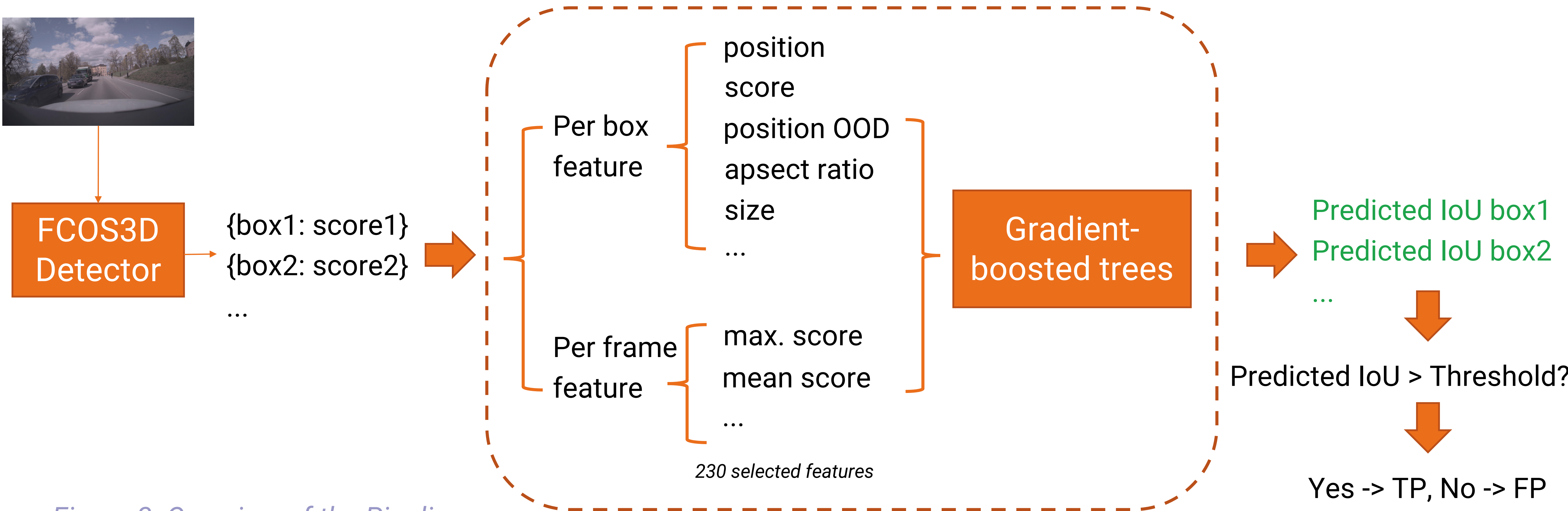


Figure 3: Overview of the Pipeline

* For this dataset, Zenseact AB has taken all reasonable measures to remove all personally identifiable information, including faces and license plates. To the extent that you like to request removal of specific images from the dataset, please contact privacy@zenseact.com <https://zod.zenseact.com/>

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on the basis of a decision by the German Bundestag

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