Improving Multi-class Vehicle Detection Using YOLOv5 Coupled with Hyperparameter Evolution

Team: Transportist

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Abstract

Deep convolutional neural networks have performed remarkably well on many Computer Vision tasks including vehicle detection. Our experiments found that the combination of hyperparameter evolution and model ensemble using YOLO provide superior results in multi-class vehicle detection problem .

1 Introduction

- We used YOLOv5 [1] coupled with hyperparameter evolution for the vehicle detection problem
- Scarcity of image was tackled by image augmentation
- Multiple models based on different optimizers were ensembled for building a stronger model
- Workflow:

2 Hyperparameter Evolution

- Hyperparameters were evolved using genetic algorithm for 300 generations
- These hyperparameters were evolved:
  Lr (Learning rate) , momentum, weight_decay, warmup_epochs, warmup_momentum, warmup_bias_lr, box, Cls, cls_pw, obj, obj_pw, iou_t, anchor_t, fl_gamma, hsv_h, s v, degrees, translate, Scale, shear, perspective, flip, mosaic. Mixup
- Hyperparameters were separately evolved for different YOLOv5 model configurations (s, m, l and x) and optimizers (ADAM and SGD)

3 Augmentation and Ensembling

- Object detection performances are further generalized by image augmentation processes.
- We used *gamma, scale, shear, perspective, flip, mosaic and mixup* for augmentation of data as a part of the hyperparameter evolution process
- Model ensemble is utilized to combine different weaker models to build a stronger model.
- in the final round, we ensembled 11 different models trained by using corresponding different hyperparameters, including different configurations of YOLOv5 m, l, and x.

4 Results

Description	1st round mAP@ [0.5:0.95]	2nd round mAP@ [0.5:0.95]
Default YOLOv5	0.1567	
Hyp evolved (YOLO v5), Augmentation, Ensemble (4 models)	0.1895	0.2357
Hyp evolved (YOLO v5), Augmentation, Ensemble (11 models)		0.2705

5 Inferences

6 Conclusion

- Hyperparameter evolution and model ensemble can improve the YOLOv5 mAP@0.5:0.95 by 3-4 percent.
- Training separate models with different optimizers can further improve the generalization of the model

References

1. Glenn Jocher, Alex Stoken, Jirka Borovec, NanoCode012, ChristopherSTAN, Liu Changyu, … Prashant Rai. (2020, October 29). ultralytics/yolov5: v3.1 - Bug Fixes and Performance Improvements (Version v3.1). Zenodo. http://doi.org/10.5281/zenodo.4154370