Karlsruhe Institute of Technology

Master Thesis

The performance of object detection decreases with the increasing fog severity.

Uncertainty Guided Cross-Domain Object Detection

While deep learning models have demonstrated remarkable capabilities in object detection tasks, their performance can be significantly compromised under challenging visibility conditions, such as fog and night. To overcome this performance drop, supervised methods require extensive annotations, which are expensive and impractical. Cross-Domain Object Detection (CDOD) has been proposed to address this issue, where a pre-trained object detector is adapted from a labeled source domain (e.g., clear weather) to an unlabeled target domain (e.g., fog). Recently, Mean Teacher (MT) based approaches have emerged as a promising solution for unsupervised CDOD, demonstrating state-of-the-art performances [1,2]. However, the performance of these approaches depends heavily on the quality of pseudo-labels.

As illustrated in the accompanying figure, the quality of pseudo-labels generated by the model decreases with increasing fog severity. This enables the possibility to evaluate the quality of pseudo-labels without access to ground truth and allows for a gradual adaptation to the target domain.

The topic offers the potential for publication at international conferences.

The proposed thesis consists of the following parts:

+ Literature research about cross-domain object detection
+ Literature research about image-level and instance-level uncertainty for object detection, e.g. [3]
+ Implementation of a quality vector representing the uncertainty of visibility conditions
+ Train DNN for cross-domain object detection
+ Evaluation on Foggy Cityscapes dataset

I am happy to answer any questions you might have. Feel free to ask for an appointment or directly ask at my office!

[1] Li Y J, Dai X, Ma C Y, et al. Cross-domain adaptive teacher for object detection[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2022: 7581-7590.
[2] Chen M, Chen W, Yang S, et al. Learning domain adaptive object detection with probabilistic teacher[J]. arXiv preprint arXiv:2206.06293, 2022.
[3] Oksuz K, Joy T, Dokania P K. Towards Building Self-Aware Object Detectors via Reliable Uncertainty Quantification and Calibration[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2023: 9263-9274.

Institute of Measurement and Control Systems (MRT)
Prof. Dr.-Ing. Christoph Stiller

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Programming language(s)[1]**:**
Python advanced

System, Framework(s):
Linux, Pytorch, Detectron2

Required skills:
- Prior knowledge of deep learning for CV
- Work on your own

Language(s):
German, English

For more information please contact:

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Or directly send in your application including your current grades as well as our questionnaire!

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[1] **skill levels:**
beginner < 500 lines of code (LOC)
advanced 500 – 5000 LOC
proficient > 5000 LOC