Summarizing and Searching Video: Domain Adaptation

Problem:
Despite impressive improvements in machine learning systems in recent years, **classifiers still struggle to perform when there is little or no training data in the target environment.** Semantic differences, such as perspective and object density, between source and target environments can significantly degrade classifier accuracy. Non-semantic differences, such as differences in object environment, can significantly degrade classifier accuracy. Differences between the trained and real world data sets also hamper classifier performance.

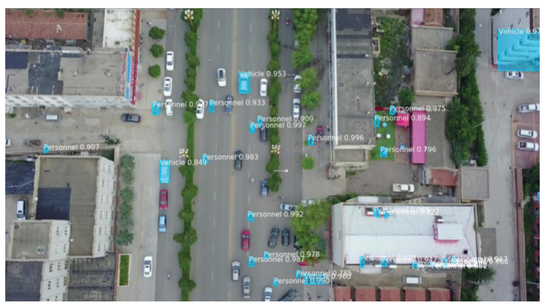
This is particularly problematic in the tactical setting, where there is limited image data.
Data from target environments may be scarce, or have few examples of object classes.
Data may be heterogeneous with regard to perspective, scale and quality. It may also have limited to no metadata.

Solution:
- Stratification of existing data to match semantics of the target environment
- CycleGAN for unsupervised style transfer between images
- Object detection & classification with mask-RCNN trained on existing, labeled data which has had style transfer applied to it

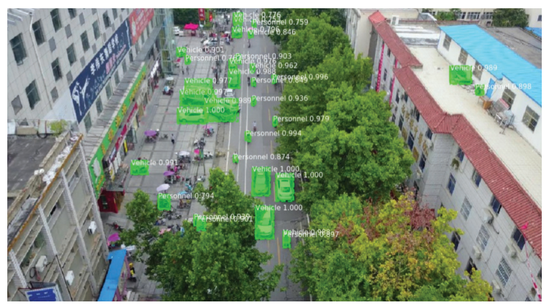
Enabling use of existing labeled data sets to **train detectors in low data environments**

Object Identification

Poor Object Identification



Improved Object Identification



@article{zhuvisdrone2018,
title={Vision Meets Drones: A Challenge},
author={Zhu, Pengfei and Wen, Longyin and Bian, Xiao and Haibin, Ling and Hu, Qinghua},
journal={arXiv preprint arXiv:1804.07437},
year={2018}
}

Results:
Our work suggests that with significantly different datasets, style transfer is insufficient to create a substitute for training data within the target domain. Furthermore, supplemental data with or without style transfer to target environment has shown minimal benefit as a supplement to target domain data.

Future Directions: Improved semantic matching of target and source images
- Currently, the only semantics we match on are object density. This needs to be expanded to include other image features such as perspective and scale.
- After improved semantic matching, we can again ask if this observation holds to where the target and source environments are semantically similar.

Automatic determination of object identification quality
- Create a flag for when automatic object identification quality is suspect.

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