Vehicle Re-Identification with the Space-Time Prior

Team iamai

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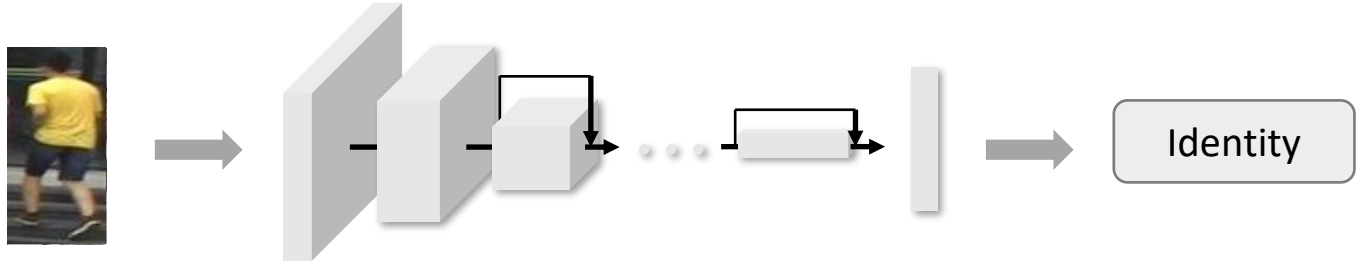
Vehicle Re-Identification:
Identify the vehicles across cameras.



1. Domain transfer problem

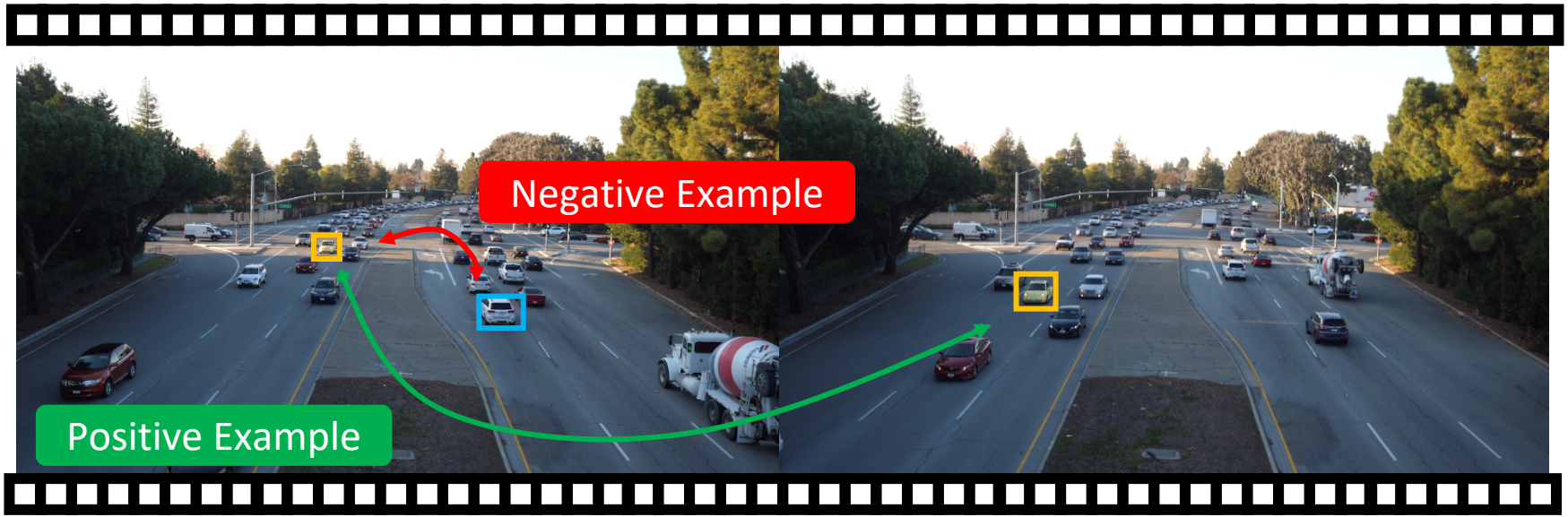
Learned CNN fails on testing data of different domain.

2. Lack of labeled training data

Learned CNN is not general enough for unseen data.

Training

Testing



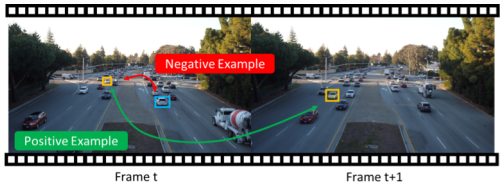
Frame t

Frame t+1

The space-time prior within the video:

Vehicle pair in same video frame must be different identity.

Vehicle pair in same trajectory must be same identity.



Testing dataset

Trai taset

Negative

Positive

Batch-hard training

Shared

ID classification loss

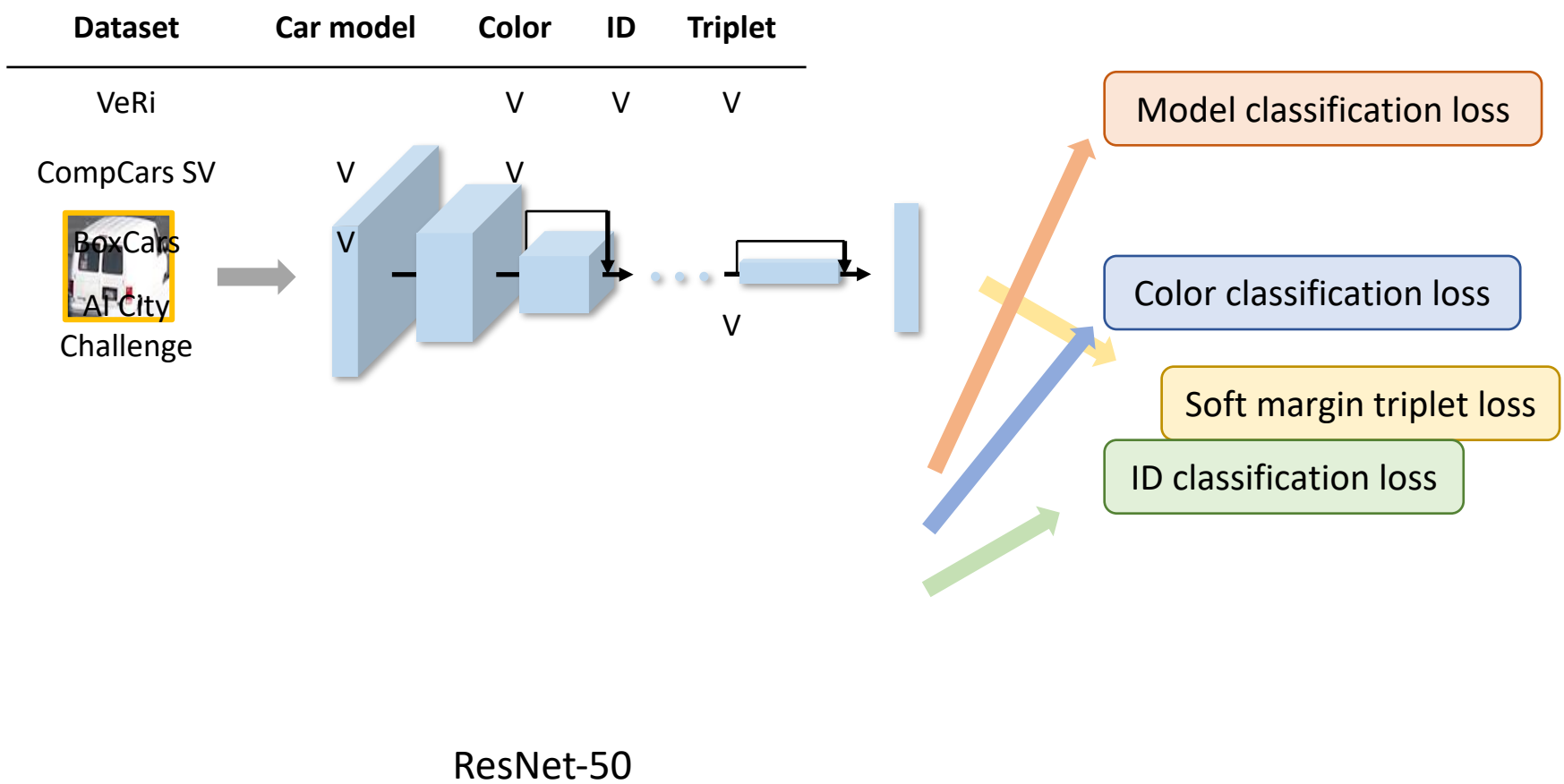
Soft margin triplet loss

ID classification loss

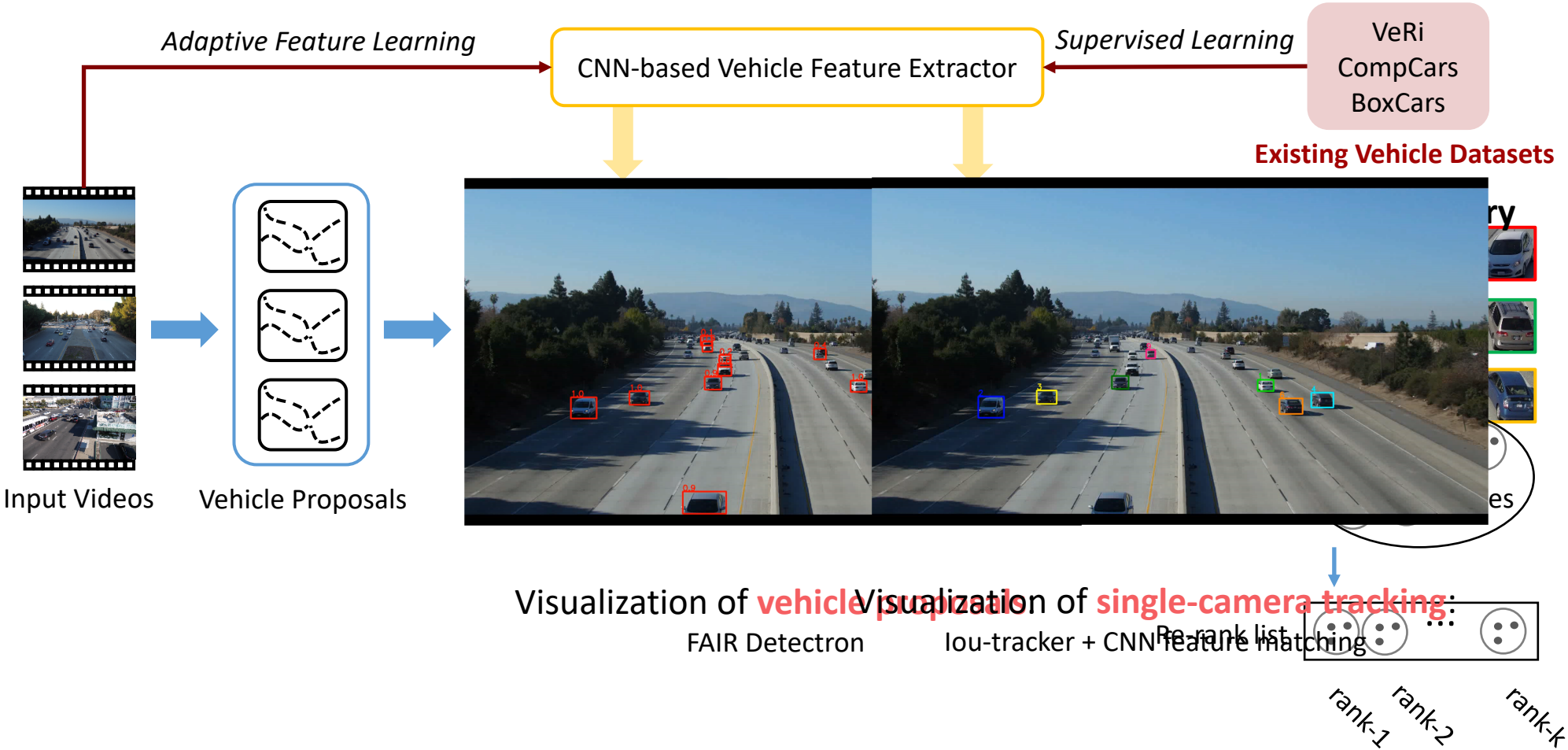
Triplet CNN with **Adaptive Feature Learning (AFL)**:

Train CNN with labeled training data and
examples discovered by space-time prior.

A. Hermans et. al. “In defense of the triplet loss for person re-identification.” arXiv, 2017.



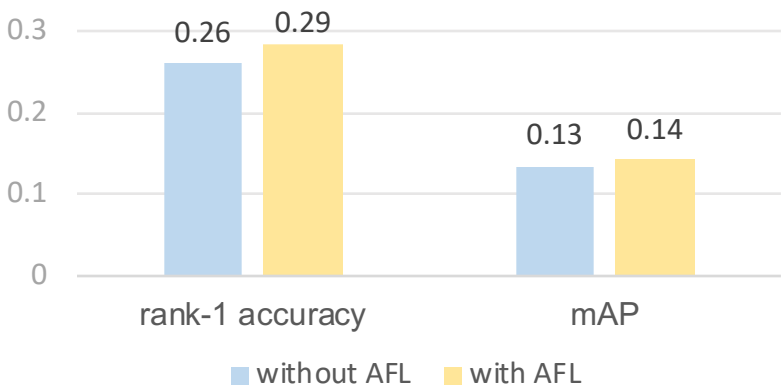
X. Liu et. al. “Large-scale vehicle re-identification in urban surveillance videos.” ICME, 2016.
L. Yang et. al. “A large-scale car dataset for fine-grained categorization and verification.” CVPR, 2015.
J. Sochor et. al. “Boxcars: Improving fine-grained recognition of vehicles using 3-d bounding boxes in traffic surveillance.” TITS, PP(99):1–12, 2018.

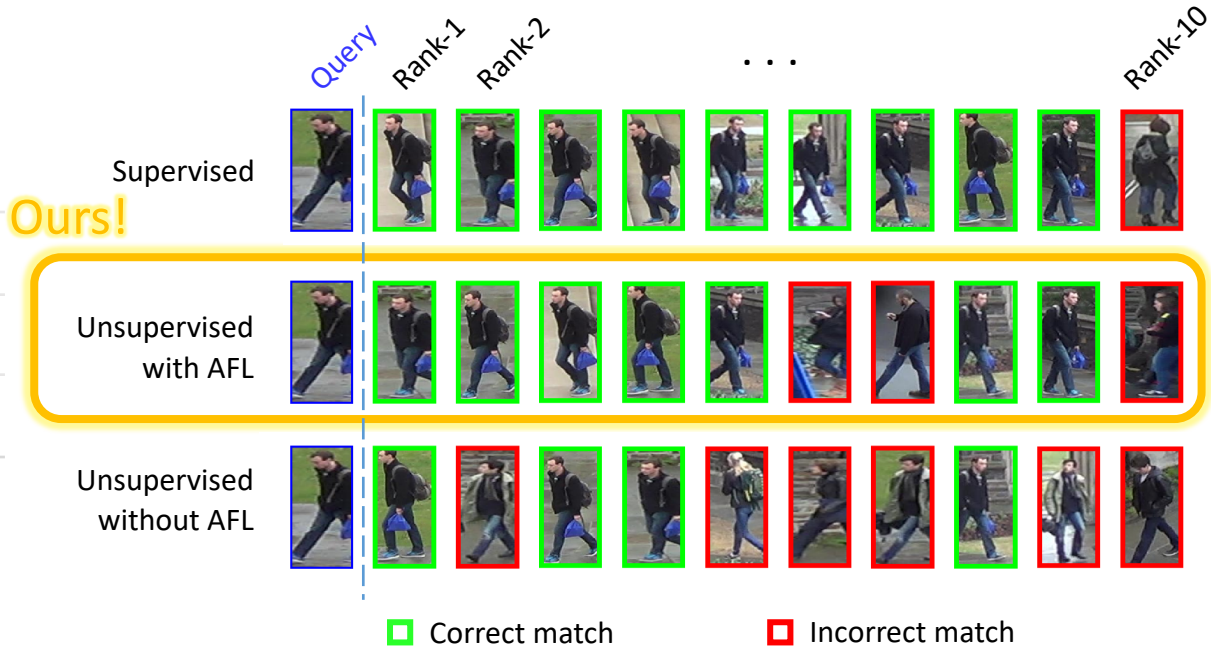


R. Girshick et al. Detectron. https://github.com/ facebookresearch/detectron, 2018.
E. Bochinski et al. “High-speed tracking-by-detection without using image information.” AVSS, 2017.

Adaptive Feature Learning (AFL) effectiveness on human re-identification

Train on Market-1501 dataset.
Adapt to DukeMTMC-reID dataset for testing.

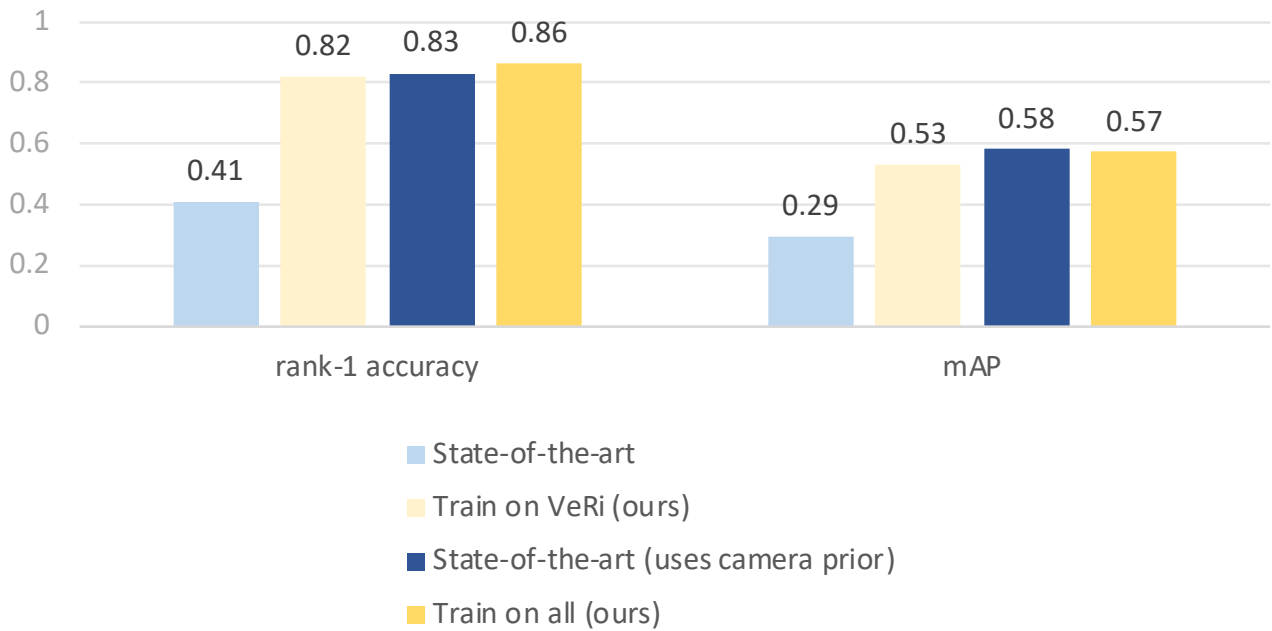




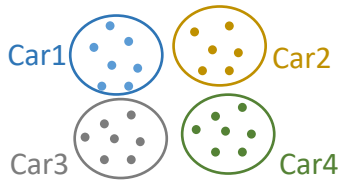
L. Zheng et al. “Scalable person re-identification: A benchmark.” ICCV, 2015.
Z. Zheng et al. “Unlabeled samples generated by GAN improve the person re-identification baseline in vitro. ” CoRR, 2017.

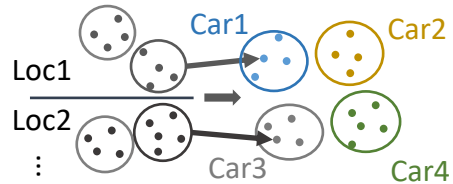
CNN performance on vehicle re-identification

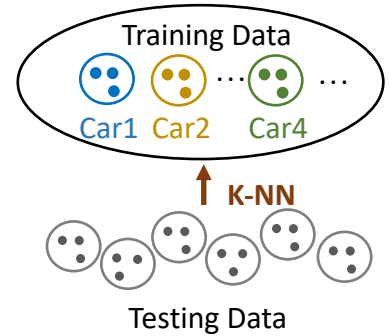
Evaluate on VeRi dataset.

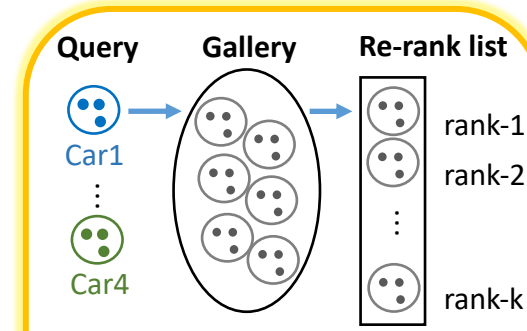


X. Liu et. al. “Large-scale vehicle re-identification in urban surveillance videos.” ICME, 2016.
Y. Shen et al. “Learning deep neural networks for vehicle re-id with visual-spatio-temporal path proposals.” CVPR, 2017.





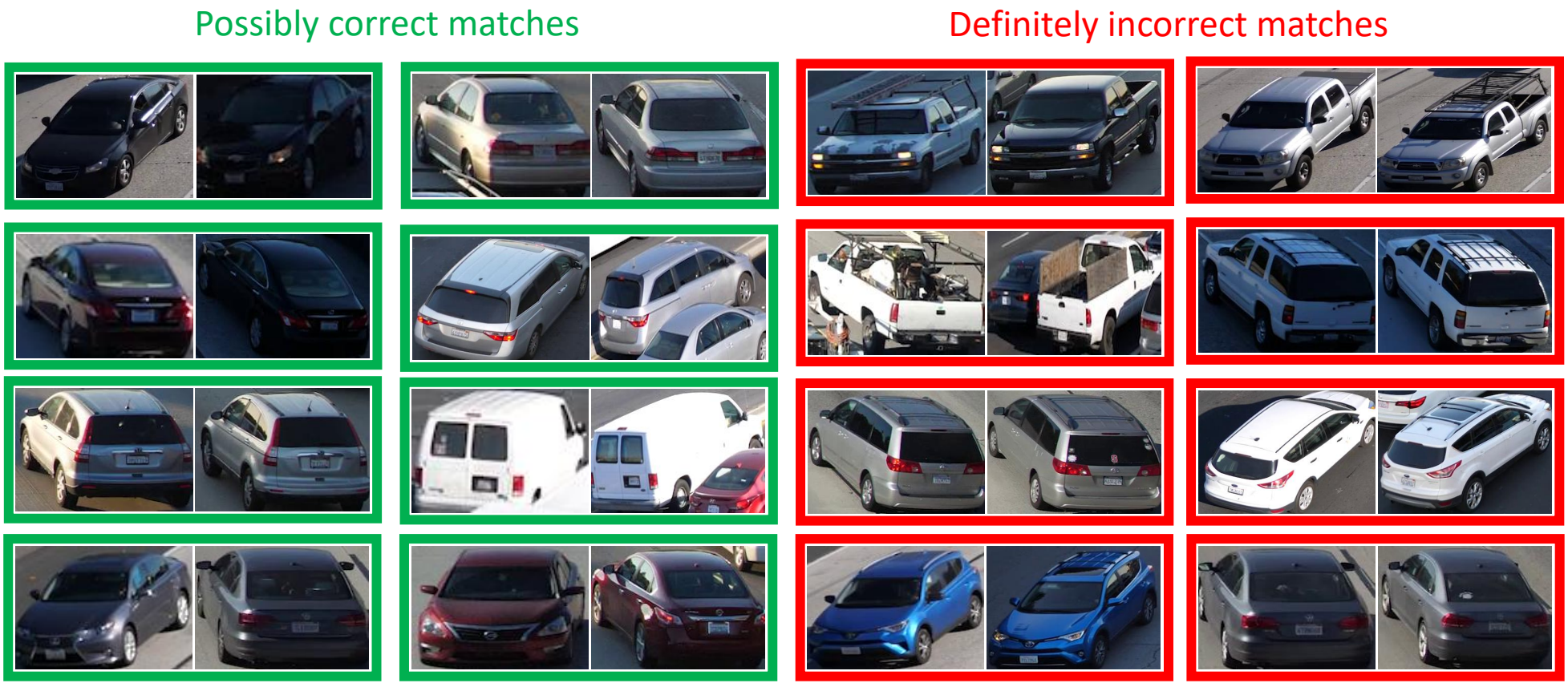




	K-means Clustering	Bottom-Up K-means	K-NN Search	Query-Gallery
TDR↑ Track detection rate	0	0	0.1429	0.5714
PR↑ Localization precision	0.0006	0.0015	0.0020	0.0007
S3↑ Average of TDR and PR	0.0003	0.0007	0.0725	0.2861

Submission results on NVIDIA AI City Challenge Track 3

Test with different multi-camera matching algorithm.



Visualization of vehicle re-identification system results

Discussion

1. Limitations of space-time prior

Hard to discover negative pairs with similar appearance with space-time prior

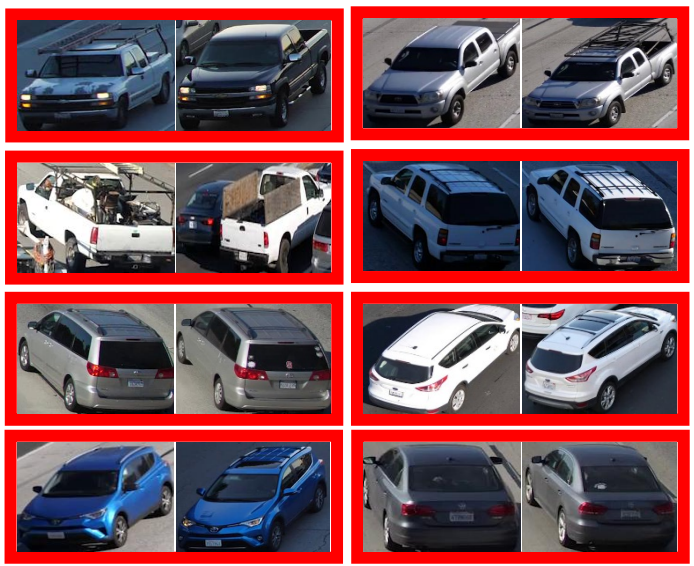
2. Evaluation metrics

Biased toward **TDR** due to insufficient ground-truth vehicle

3. Datasets

Lack of labeled vehicle re-identification datasets

Definitely incorrect matches



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TDR:	**Track detection rate**
PR:	Localization precision
S3:	Average of TDR and PR

Summary

- Introduce adaptive feature learning with space-time prior
- Verify adaptive feature learning on both human and vehicle Re-ID
- Achieve great results on NVIDIA AI City Challenge Track 3

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