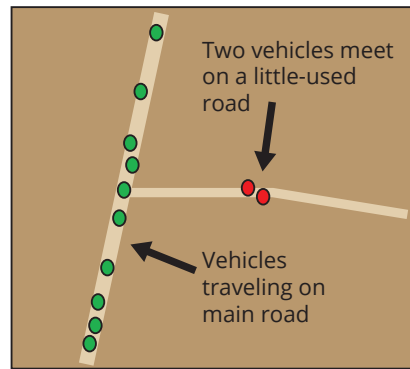


Video Summarization and Search: Object Tracking

Problem:

Aerial surveillance demands full attention to video by PED teams

- Manual, error-prone process
- Technical barriers including object detection, and tracking
- Limitations result in poor pattern detection in a surveilled region



- Vehicle tracks used to train LSTM autoencoder that learns normal behavior in order to identify anomalous tracks
- Results shown are for perfect data -- reality is not so pretty due to inadequate object detection and tracking
- This results in lost tracks and many "tracklets" that are difficult to correlate

Solution

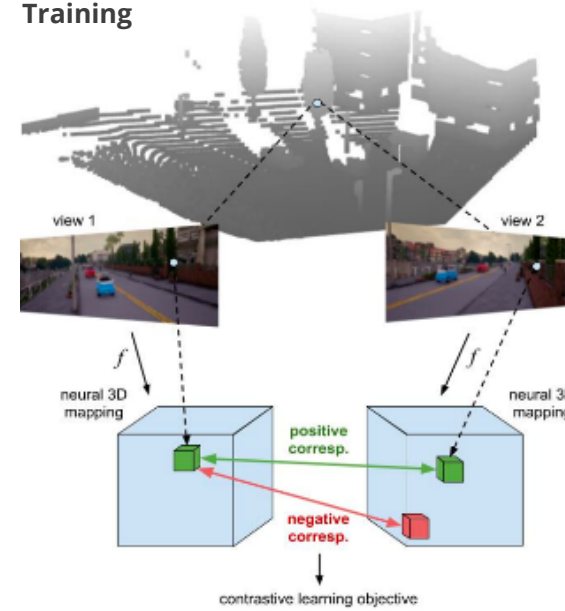
- Work directly with DoD to improve pattern detection in aerial surveillance data patterns
- Work with researchers to address core technology problems of tracking of objects

Impact (FY18-20)

- Improved DoD pattern detection in aerial surveillance data
- Developing unsupervised 3D tracking algorithms to improve on other unsupervised methods and achieve performance similar to supervised methods

3-D Tracking Research: **learning correspondence** from **static 3D points** causes **3D object tracking** to emerge.

Training



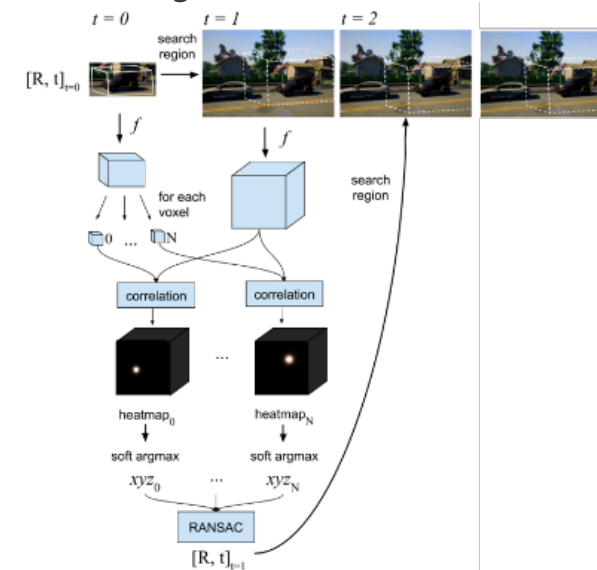
Given the bounding box for object

- Generate features for the object
- Generate features for search region
- For each voxel of object, compute correlation with search region
- Estimate the total motion with RANSAC
- Update the box automatically

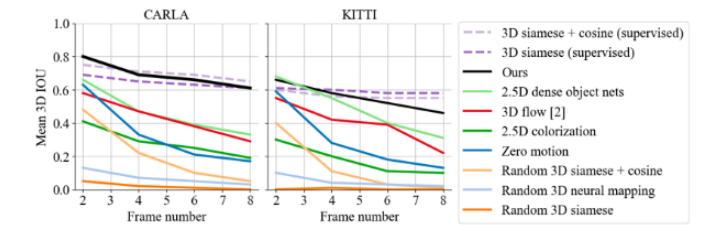
Given 2 viewpoints of the same object:

- a neural 3D mapping for each
- Identify the corresponding voxel pair in the two mappings
- Treat all other mappings as negative correspondences
- Train the features to indicate the correspondences automatically

Tracking



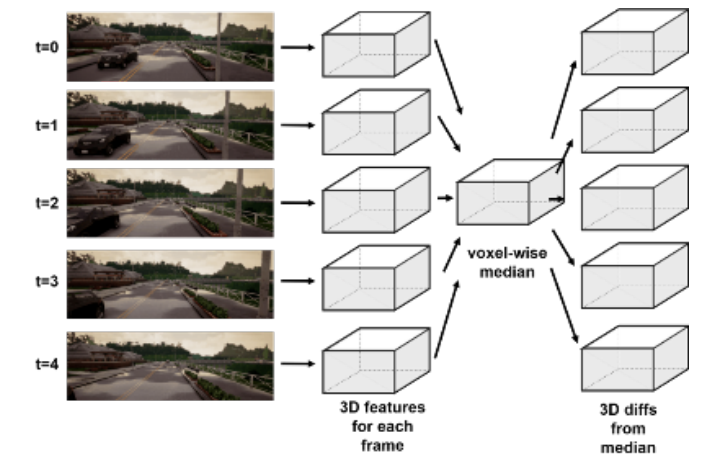
Results: Tracking based on learned correspondence of points



Object Discovery

What if the need is for a system that will discover objects autonomously?

- Extract 3D features for each frame
- Determine voxel-wise median
- Determine the difference from the median for each frame



Early results are promising!

- Work on 3D tracking will continue as part of Adam Harley's work toward his PhD at Carnegie Mellon University

Contact:

Ed Morris
info@sei.cmu.edu

Adam Harley
info@cmu.edu

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