PREVAIL (PREDICTIVE VEHICLE ACTIVITY FOR IDENTIFICATION & LOCATION) HAYSTAC LIGHTNING TALK

03.22.2022

Areté POC
Dr. Timothy Klein
Principal Scientist
(256) 715-9572
tklein@arete.com

EXCELLENCE

- An integrated innovation engine that provides exceptional value
- A multi-disciplinary, world-class workforce that solves problems in original ways
- Iterative, rapid prototyping that dramatically reduces development timelines
- Ethical, professional, client focused

CORE COMPETENCIES

- Detecting weak signals in heavy clutter with low false alarms
- Low-SWaP sensors with real-time fusion
- Extracting maximum performance from systems
- Applying interdisciplinary expertise across domains
- Rapid prototyping and production

Discover.

Develop.

Deliver.

DESCRIPTION

- Employee-owned with small business status
- 350 employees, 75% with advanced degrees
- Nine U.S. Locations: AL, AZ, CA, CO, FL, VA
- 199K square feet of lab/office/ production capacity; ISO 9001:2009, AS9100 Rev C compliant
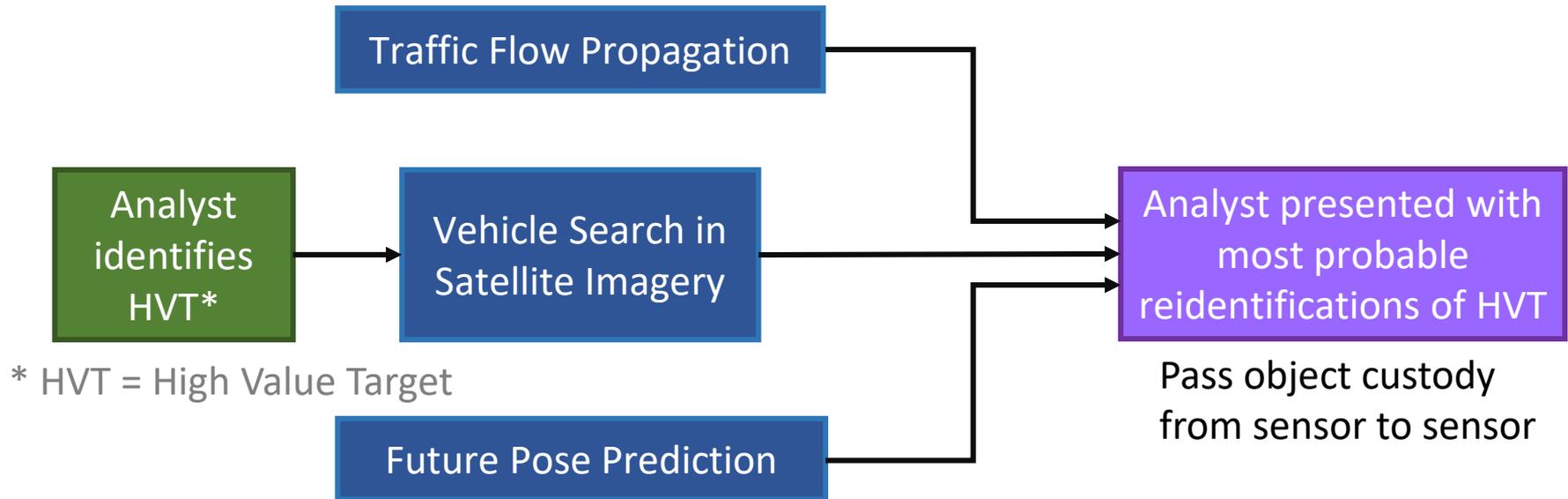- > 40 years of government experience

APPROACH

Rapid, creative, end-to-end development

- Discover: A science and technology engine advancing state-of-the-art sensing
- Develop: A responsive collaborator rapidly maturing prototype system solutions for new and existing sensors
- Deliver: Reliable producer of high-performance systems; typically low-SWaP

PreVAIL Components

PreVAIL: Predictive **V**ehicle **A**ctivity for **I**dentification and **L**ocation

Traffic Flow Propagation

Analyst identifies HVT*

Vehicle Search in Satellite Imagery

Future Pose Prediction

Analyst presented with most probable reidentifications of HVT

* HVT = High Value Target

Pass object custody from sensor to sensor

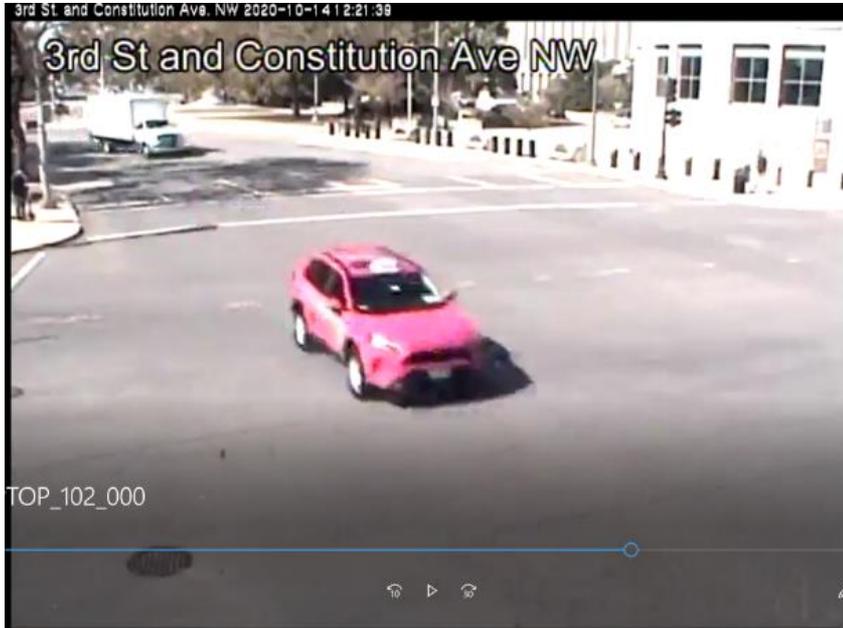*Reveal subtle, anomalous vehicle behavior across multiple sensors, times and locations*

EXAMPLE FROM REAL-TIME DEMO

Step 1: Initial Detection

First positive ID occurs in a traffic camera at 2:21 pm:

14:21:39

We make the assumption that an analyst reidentifies the vehicle in satellite imagery at 3:48 pm:

day1_arete_WV2-1_884

Now search for vehicle in next satellite image 11 seconds later.

This step was performed during the live demo

Steps 2 & 3: Search and prediction

```
last known location -77.04894715836603/38.88718051920031 at time 1602704893.0
5 detections identified
2 detections identified after fusing with traffic propagation.
```


Traffic propagation

Detections

Fused detections

False Alarm

True Detection
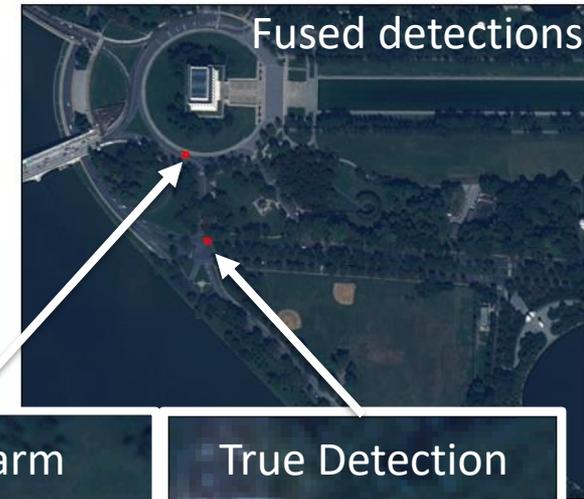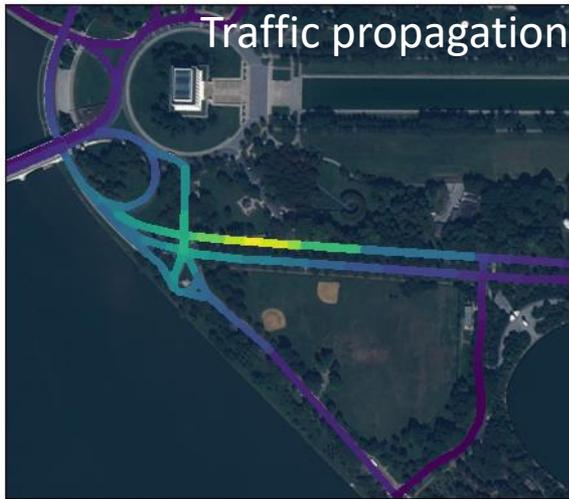
This step was performed during the live demo

Step 4: Vehicle identification

Vehicle of interest is positively identified in satellite image at 3:48 pm

Track kinematic metrics allow for interpretation of normal/anomalous behavior
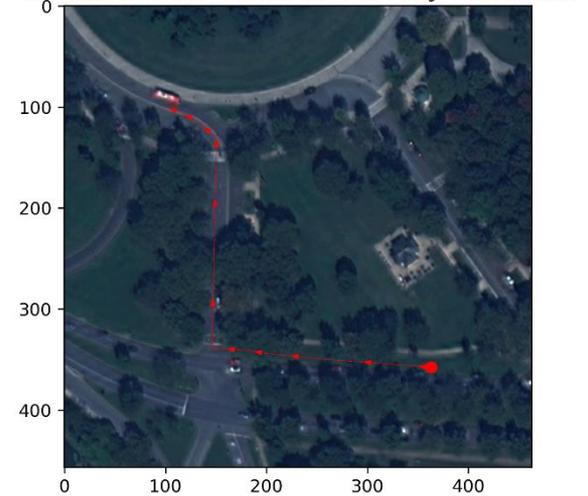
Positive Detection

day1_arete_WV2-2_884

$\Delta t = 11.00$ sec : D=97.52 meters : $V_{avg} = 19.83$ mph

False Alarm

$\Delta t = 11.00$ sec : D=242.97 meters : $V_{avg} = 49.41$ mph

This step was performed during the live demo

Extracting subtle intent

- Social forces model (SFM) quantify track motion based on kinematic equations

- The computed social force parameters are sensitive to anomalous behavior

Conclusions

- Main elements of PreVAIL framework:

  - Traffic Prediction: Predict where future event could occur

  - Pose Prediction: Predict what to look for in the future

  - Metadata kinematics allows separation of normal and anomalous behavior

- Currently have real-time code to maintain custody of vehicles between sensors in demo data collect

- Approach is sensor / modality / object agnostic

- Methodology could be applied to human movement data

THANK YOU

Areté

DISCOVER. DEVELOP. DELIVER.