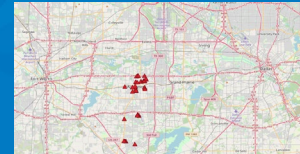
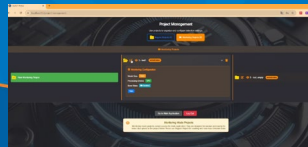


A Real-World Testbed for Transportation Innovation in Arlington

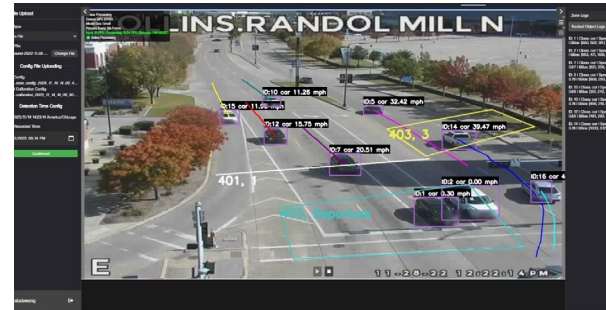
For the ITS Texas Conference ,
Nov 2025, DFW

Christopher Funches, P.E., City Traffic Engineer, Arlington, Tx
Taylor Li, P.E., Ph.D., Associate Professor, UTA



Outline

- Introduction
- AVAST-NG, an AI video solution to traffic management
- Future work



Introduction

UTA



Timeline



- City of Arlington (CoA) funded UTA a seed project to explore novel technologies for traffic management in 2022
 - This effort catalyzed a standalone software tool with the open-source computer vision engine (Yolo), AI-powered Video Analysis Solution or **AVAST**
- CoA/UTA evaluated AVAST's counting accuracy with 4 types of traffic cameras deployed at 6 locations in Arlington
 - 98+% accuracy
- COA decided to escalate this effort and opened all traffic camera feed to UTA via a high-speed fiber connection in 2023, better using the traffic cameras and supporting more research activities

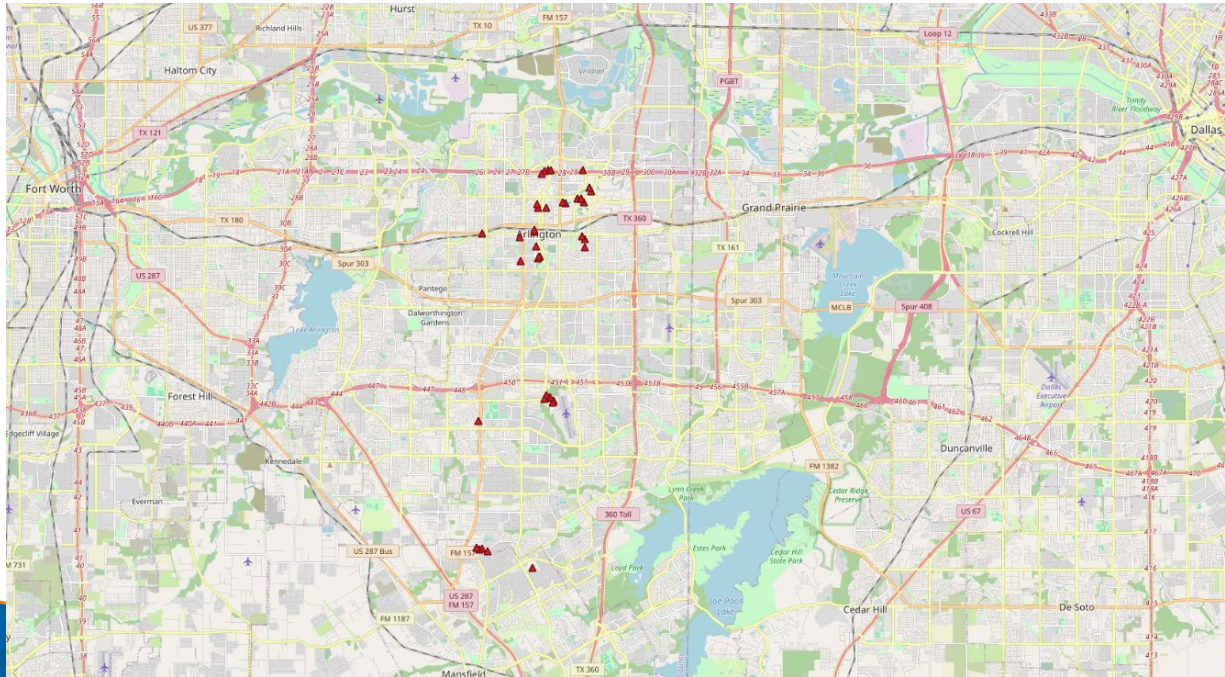
The fiber network construction (2023~2025)



- The IT teams on both sides (CoA/UTA) were super cautious and had many meetings to discuss the possible options
- Arlington's traffic network is connected to UTA campus from a gateway location with a high-speed fiber connection
 - A “everything-to-everything” firewall rule.
- UTA added additional fiber hops to connect from the gateway to our traffic research lab
 - UTA set up an isolated virtual LAN (VLAN) for one dedicated computer to separate this connection from UTA campus network
 - Only two knowledgeable persons on campus have access to that computer

In a nutshell

More than 200 locations, multiple types of traffic cameras, full access to multiple intersections

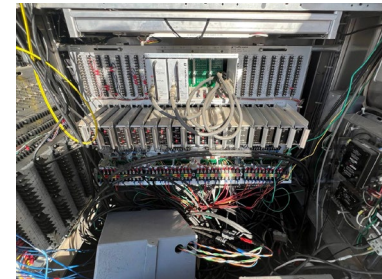


A real-world intersection testbed for smart traffic technologies

Open to external collaborators



- COA will open one intersection as a real-world intersection testbed to support both research and new commercial solutions
 - W Lamar Blvd & N Davis Dr (32.765135, -97.1230232)
 - Currently behind the firewall, but it may be temporarily isolated and networked with 5G network during projects.
 - Next to Lamar High School with AM/PM peaks, 8 phases, 4 FYAs and 4 crosswalks
 - Support UTA's research activities
 - Support external collaborations with the ground help from UTA (e.g., proof of concept, demonstration).



Next Generation of AVAST: AVAST-NG

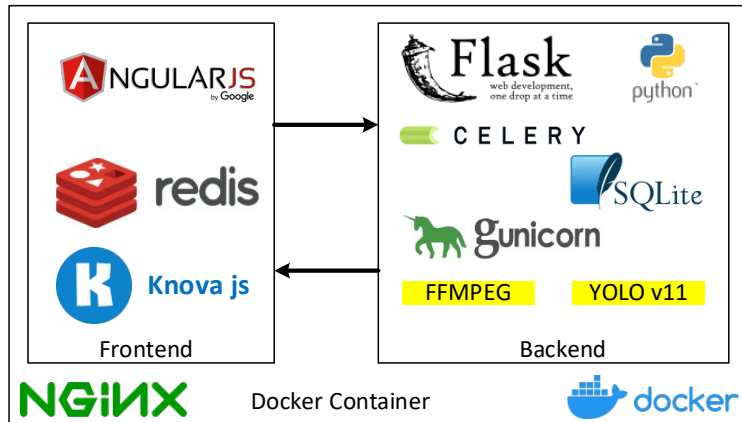


Parallel development at UTA between 2023~2025

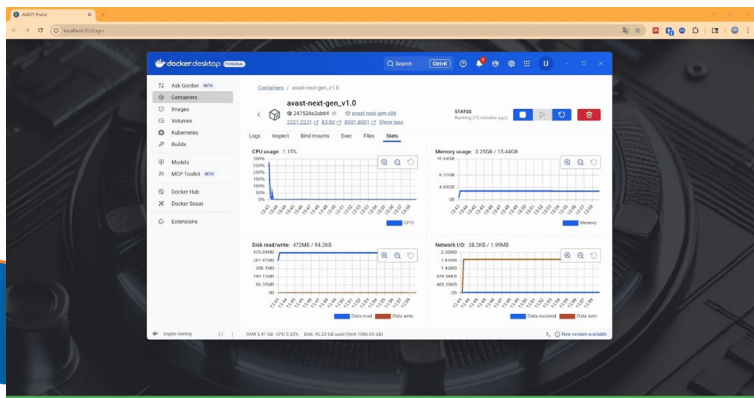


- **Lessons learned from early deployment**
 - Traditional deployment (like installing a local software) faces challenges from the IT department (some dependent libraries may be restricted)
 - Connectivity of traffic cameras are not ideal
- **Modernize the development and deployment**
 - Docker-based (isolated environment from the host computer)
 - Full stack (web interface)
- **Enhance its flexibility and extend to other areas**
 - Traffic safety analytics
 - Generic tracking engine for safety-centric traffic operations

AVAST-NG: Full-stack System Overlook





- Uses the state-of-the-art modern architecture.
- Support both CPU and GPU for various scenarios
- Fully optimized architecture and up to 5x faster than standard open-source Yolo engine
 - Redundancy design for poor connections
- Remote access to its web front, no local software installed
- Delivered and upgraded over the air using a single file



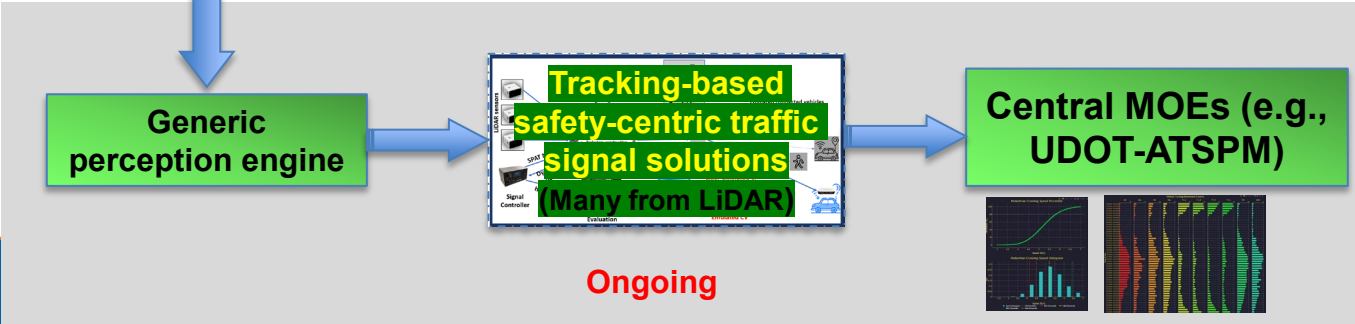
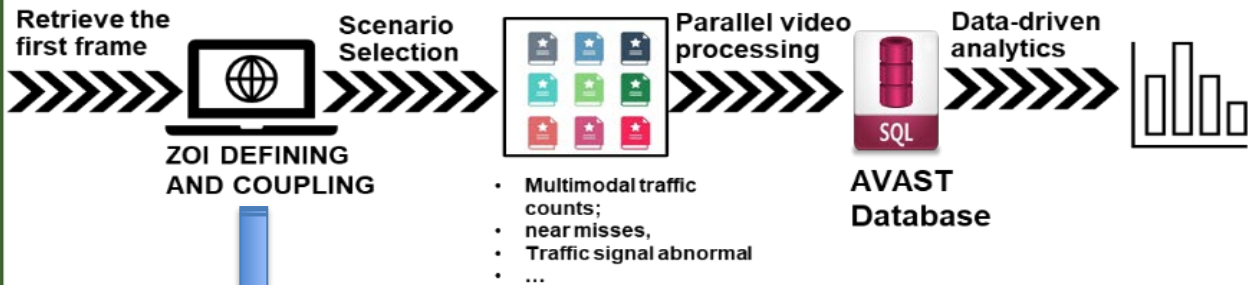
AVAST-NG workflow



Recorded videos (fixed spots)

Live IP traffic cams



AVAST-NG's target scenarios

- **PTZ cameras at intersections or in the mid-blocks**
 - Each PTZ cam and a preset position will be treated as a separate project
- **Three model:**
 - **Real-time processing**
 - Continuous remote connecting is not stable
 - **Off-line video processing**
 - **Quasi-real-time processing**
 - local recording and periodical uploading
 - (5~15 minutes delay)



Critical steps: Zone of Interest (ZOI) Setup and modification



ZOI Setup and Modification

- **ZOI Setup**
 - **Line zones and polygon zones**
 - Draw ZOI on the video view
- **ZOI Modification**
 - Interactive and automatically assigned a unique ID
- **ZOI Configuration Management**
 - ZOI config file is transferrable.

Critical Step: Relational ZOI Coupling

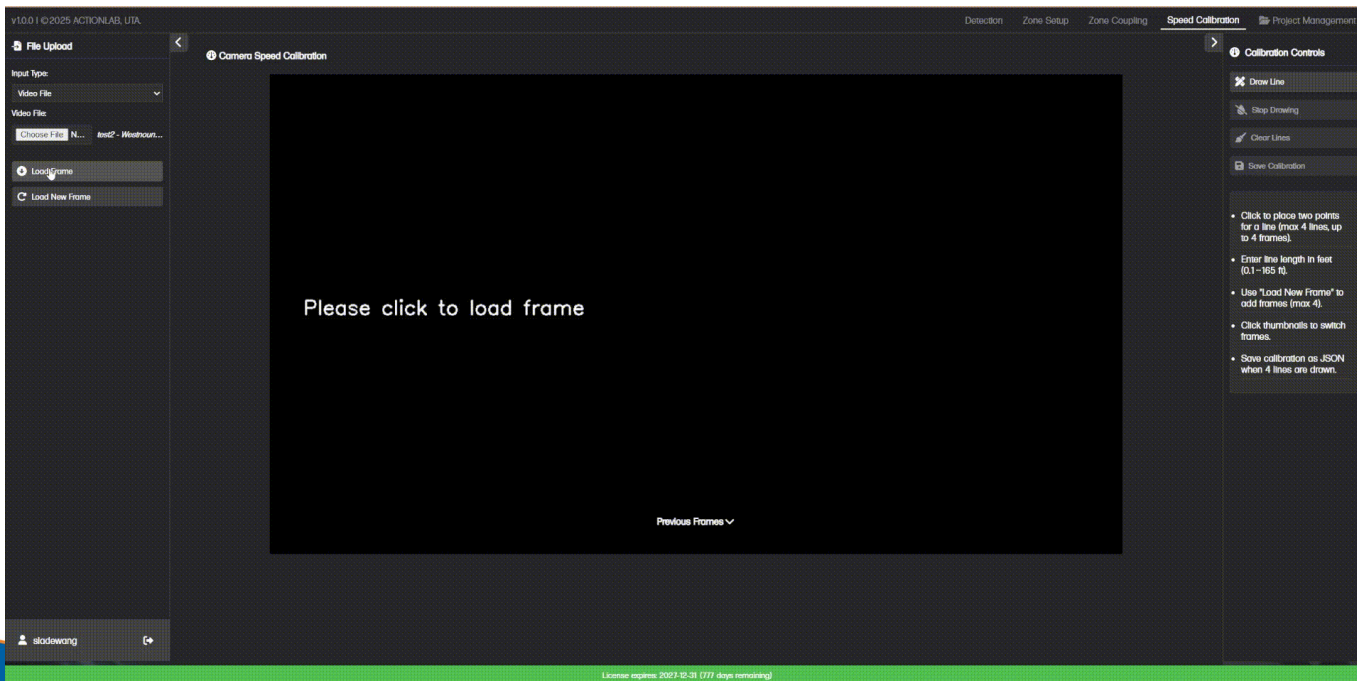
Object tracking is based on objects' traces in relational ZOIs, not their perceived waypoints (x, y, t)



Four Zone Types

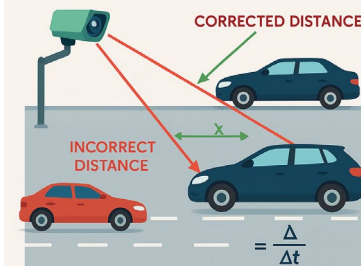
- **Default/Origin ZOI**
 - Triggers whenever an object enters the zone
 - Output via connection API
- **Count ZOI**
 - Records count and object types
 - Output via connection API
- **Near-Miss ZOI**
 - Activates when two objects from different directions enter with a speed above the threshold
 - Saves a 30-second video clip
- **Trigger/Event ZOI (as generic perception output)**
 - Works in conjunction with counting zones and near-miss zones
 - Output via connection API

Critical Step: Speed Calibration



- **Multi-point calibration to mitigate parallax distortion and output accurate speed, a major disadvantage to radar and LiDAR in the past.**

PARALLAX DISTORTION



Vehicle appears closer than it is,
speed measurement too high

A demo of AVAST in Detection



The screenshot displays the AVAST detection software interface. The main window shows a dark background with the text "Detection Stopped" and "Click START to begin detection". The interface includes a left sidebar with "File Upload" and "Config File Uploading" sections, a top navigation bar with "Detection", "Zone Setup", "Zone Coupling", "Speed Calibration", and "Project Management", and a right sidebar with "Detection", "Tracking", and "Preferences" tabs. The "Detection" tab is active, showing settings for Model Size (Small), Processing Device (GPU), Image Size (640), Process Every Nth Frame (3), Confidence Threshold (0.5), IoU Threshold (0.7), and Max Detections (50). The "Road Object Detection" section has checkboxes for Car, Person, Bicycle, Motorcycle, Truck, Bus, Train, and Airplane, all of which are checked. The "Roadside Object Detection" section has checkboxes for Traffic Light, Stop Sign, and Parking Meter, all of which are unchecked. A green bar at the bottom indicates "License expires: 2027-12-31 (1777 days remaining)".

v1.0.0 | © 2025 ACTIONLAB, UTA

File Upload

Input Type: Video File

Video File: Westbound-2022-11-26-... Change File

Config File Uploading

Zone Config: test2 - zone_config_2025_11_14_14_05_4...

Speed Calibration Config: test2 - calibration_2025_11_14_09_30...

Detection Time Config

© 2025/11/14 14:22:53 America/Chicago

Video Recorded Time: 11/10/2025 06:14 PM

Confirmed

Detection Stopped

Click START to begin detection

slodewang

License expires: 2027-12-31 (1777 days remaining)

Detection Zone Setup Zone Coupling Speed Calibration Project Management

Detection Tracking Preferences

Model Size: Small

Processing Device: GPU

Image Size: 640

Process Every Nth Frame: 3

Confidence Threshold: 0.5

IoU Threshold: 0.7

Max Detections: 50

Road Object Detection

Car Person

Bicycle Motorcycle

Truck Bus

Train Airplane

Roadside Object Detection

Traffic Light Stop Sign

Parking Meter

Next Steps

Next Steps

- **Scale up the usage of AVAST-NG to collect traffic data in Arlington**
 - Offer training and case studies
- **Welcome external research/industrial collaborators to utilize this testbed**
- **Deploy AVAST-NG for more agencies**
 - Research or licensing



Thank you!

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For AVAST-NG: Taylor Li Taylor.Li@uta.edu