CIVIL AND ENVIRONMENTAL ENGINEERING DEPARTMENT

CEE-22
MD1-1

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What is YOLO?

You Only Look Once (YOLO) is a deep learning detection algorithm that works in real-time. YOLO can be trained to detect any object and displays a probability on how confident the algorithm is in its results.

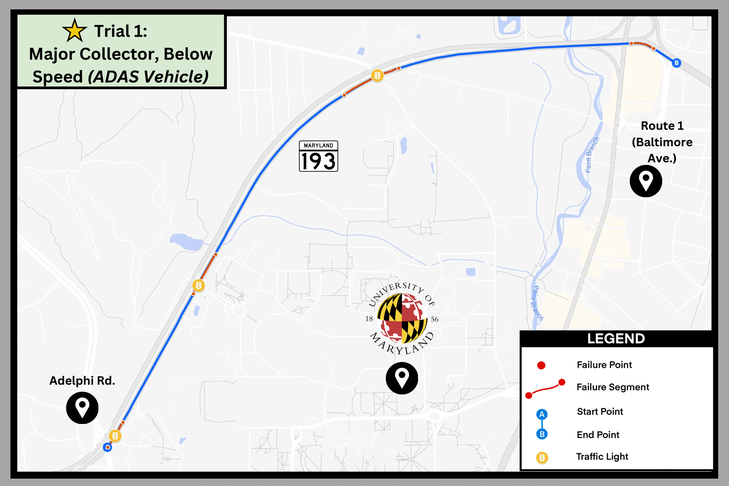

Image 1a: Major Collector, Below Speed (Trial 1, ADAS)

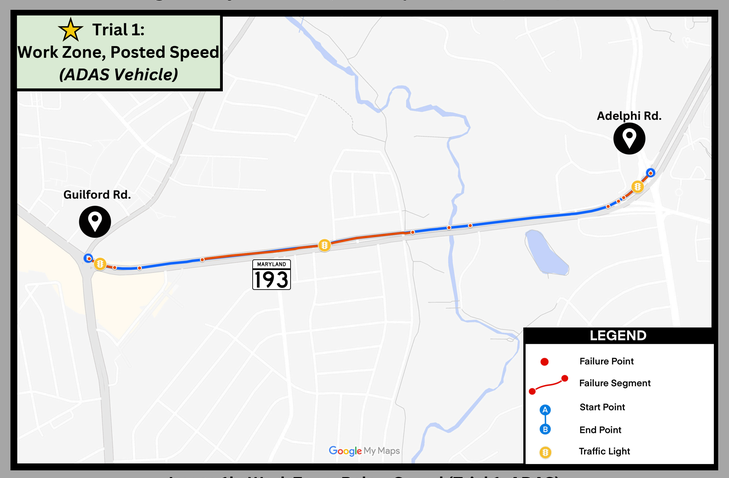

Image 1b: Work Zone, Below Speed (Trial 1, ADAS)

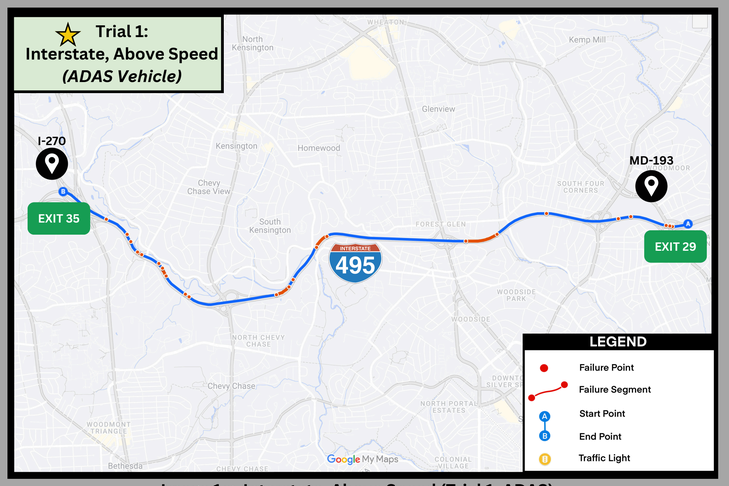

Image 1c: Interstate, Above Speed (Trial 1, ADAS)

1 Project Goals & Objectives

The main goal of this project is to improve the performance of advanced driver-assistance systems (ADAS) within vehicles on Maryland roadway infrastructure through the following objectives:

1. Create a metric to determine if YOLO can be used as a suitable analysis tool for identifying areas with inadequate infrastructure that fail to meet ADAS detectability.
2. Provide recommendations to local and state agencies to improve roadway infrastructure conditions.

2 Data Collections

The table to the *right* describes the locations of all data collection routes driven

YOLO Outputs

Image 2a: YOLO Misdetections

Image 2b: Proper YOLO Detection

Maps & Table

Images 1a to 1c, on the *left*, are maps representing data from each route evaluated. Smaller red points represent locations where the in-car ADAS system failed briefly, while long red segments indicate extended ADAS system failures.

Table 2, on the *right,* shows the total number of ADAS failure locations as well as the number of these locations in which a YOLO detection was found.

The last column of the table indicates the number of misdetections in YOLO output, as well as the location or reason for the misdetection.

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

DATA COLLECTION		
Roads	**Non-ADAS Vehicle**	
	Trial 1	**Trial 2**
Interstate 495 *Exit 29 to Exit 35*	Below Posted	Below Posted
	Posted	Posted
	Above Posted	Above Posted
Maryland 193 *Adelphi Rd to Baltimore Ave*	Below Posted	Below Posted
	Posted	Posted
	Above Posted	Above Posted
Maryland 193 *Adelphi Rd to Guilford Rd (Work Zone)*	Below Posted	Below Posted
	Posted	Posted
	Above Posted	Above Posted
Roads	**ADAS Vehicle**	
	Trial 1	**Trial 2**
Interstate 495 *Exit 29 to Exit 35*	Below Posted	Below Posted
	Posted	Posted
	★ Above Posted	Above Posted
Maryland 193 *Adelphi Rd to Baltimore Ave*	★ Below Posted	Below Posted
	Posted	Posted
	Above Posted	Above Posted
Maryland 193 *Adelphi Rd to Guilford Rd (Work Zone)*	N/A	N/A
	★ Posted	Posted
	Above Posted	Above Posted

Table 1: Data Collection Routes

ADAS/YOLO Detections				
		Interstate	**YOLO**	**Misdetects**
Trial 1	**Below Speed**	3	2	1; On Car
	Posted Speed	10	7	1; Screentear
	Above Speed	18	13	0
Trial 2	**Below Speed**	6	3	0
	Posted Speed	4	2	1; Screentear
	Above Speed	10	7	0
		Major Collector	**YOLO**	**Misdetects**
Trial 1	**Below Speed**	2	2	0
	Posted Speed	6	5	1; Screentear
	Above Speed	4	4	0
Trial 2	**Below Speed**	3	2	0
	Posted Speed	5	4	3; Tar Lines
	Above Speed	4	4	0
		Work Zone	**YOLO**	**Misdetects**
Trial 1	**Below Speed**	N/A	N/A	N/A
	Posted Speed	5	4	0
	Above Speed	8	7	1; Asphalt Patch
Trial 2	**Below Speed**	N/A	N/A	N/A
	Posted Speed	6	5	1; On Car
	Above Speed	8	6	0

Table 2: Comparing YOLO and ADAS Detections

3 Analysis

Trial 1: At least 1 YOLO detection was found in **79%** of the ADAS failure locations.

Trial 2: At least 1 YOLO detection was found in **72%** of the ADAS failure locations.

Typical failure locations included areas with **faded lane markers, highway curves, and excessive space between markings**.

4 Results & Recommendations

To Improve ADAS Detectability:

1. Use more reflective and durable material for future lane markings.
2. Lengthen lane separation lines, especially on highway curves.
3. Replace road reflectors with smaller squares to prevent vehicles from considering them as missing lane markings.

To Improve YOLO as an Analysis Tool:

1. Train YOLO more to reduce the number of mis-detections; these occurred on objects such as bridge decks and tar markings.