

Updated List of Recommended Project Ideas for Phase II

Based on the meetings with panel members, we have further narrowed down the potential Phase II research topics to: (1) AI + Edge Computing powered sensors; and (2) ramp vehicle trajectory data collection and modeling. These two topics are detailed below.

AI + Edge computing powered thermal sensors

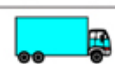
Class 1 Motorcycles		Class 7 Four or more axle, single unit	
Class 2 Passenger cars			
			
		Class 8 Four or less axle, single trailer	
			
Class 3 Four tire, single unit		Class 9 5-Axle tractor semitrailer	
			
			
Class 4 Buses		Class 10 Six or more axle, single trailer	
			
		Class 11 Five or less axle, multi trailer	
Class 5 Two axle, six tire, single unit		Class 12 Six axle, multi-trailer	
			
		Class 13 Seven or more axle, multi-trailer	
Class 6 Three axle, single unit			
			
			
			

Figure 1 FHWA Vehicle Category Classification¹

For this topic, AI algorithms will be developed to process thermal camera videos to detect and classify vehicles. We initially proposed to detect wrong-way driving and truck parking. However, detecting and classifying vehicles seem to be a more generic and challenging task. If

¹ https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm

this task is accomplished successfully, the developed algorithms can be adapted for other applications including wrong-way driving and truck parking.

Specifically, this task will involve

- Setting up thermal cameras along highways to collect traffic videos;
- These videos will be used for developing algorithms to detect and classify vehicles into the FHWA categories in Figure 1;
- Special attention will be given to Categories 9~13. For example, we will evaluate the capability of the algorithms to differentiate Category 11 from 12;
- Evaluate the algorithms under day and night conditions; and
- Evaluate the performance (e.g., speed, power consumption, bandwidth needed) of the algorithms on an edge computing device such as Jetson TX2.

Vehicle trajectory data collection and modeling

It is estimated that over 25% of fatal crashes are on horizontal curves². It is very important to have a clear understanding of how vehicles behave on those segments. This topic will utilize advanced radar sensors to collect vehicle trajectories on horizontal curves and analyze such data.

- The team will work with DOTs to identify some high-risk horizontal curves in rural areas (particularly those on unlit roads) with sight distance issues or changes in vertical alignment. Highway ramps may also be considered;
- Two high-resolution radar units will be used to collect the trajectories of individual vehicles. Each radar unit can cover a range of 900 ft. If ramps are chosen, the radar sensors can be configured to cover an entire ramp. They can also be configured to cover the 2nd half of a ramp and the adjacent highway mainline to study vehicle merging behavior;
- We plan to collect data from each horizontal curve for several days. This will allow us to fully understand how vehicles behave during both day and night and under different traffic conditions (e.g., light traffic, heavy traffic);
- Machine learning algorithms will be developed to analyze the trajectory data and identify safety improvement strategies (or risk factors) such as dynamic advisory speed and geometry changes;
- Historical crash data will be compared with the surrogate safety measures derived from trajectory data to see whether they demonstrate consistent trends. For example, the trajectory data and historical crash records may both show high crash risks during certain time periods.

² https://safety.fhwa.dot.gov/roadway_dept/countermeasures/horcurves/