Project Title: Safety in Connected Automated Vehicles in the presence of Vulnerable Road Users

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- Ohio Department of Transportation

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Project Description:

Automated Vehicles (AV's) can intermingle with pedestrians and cyclists when they are driving slowly in so-called "shared spaces". Smaller "people movers" traveling in pedestrian-dense urban areas fall in this category. However, at higher speeds on open roadways, AV's need to be aware of the possibility of emergence of occluded pedestrians or cyclists. In such situations, the pedestrians and cyclists are referred to as Vulnerable Road Users (VRU's). In our previous work, we studied AVs' energy consumption and safety when occluded pedestrians appear suddenly in front of the AV. We also indicated that an entropy-based metric may be used to quantify the value of the information regarding the location of the emergent pedestrian or cyclist. In a separate work we investigated a risk-based control strategy when the probability distribution of emergent pedestrians is known. In yet another study, we investigated the effect of adding a sensor to the roadside infrastructure to provide information to an oncoming vehicle, regarding a crossing pedestrian around the corner. We labeled this the Extended Sensor. We will continue investigating and developing our "value of information" based approach to evaluate additional sensors in the infrastructure. We shall consider regular intersections and will initiate a study on specific configurations. We will initiate a study on "indecisive pedestrians". These will be pedestrians who may stop or turn back while crossing the street, depending on their assessment of the approaching vehicle. We will assume that the vehicle will also make a decision on stopping, continuing and/or dodging the pedestrian. We will study a pedestrian crossing two lanes of traffic, with different direction traffic flow. We shall model the pedestrian dynamics for a direct two-lane crossing vs a crossing attempt with a wait stage in between the lanes.

Outputs:

As mentioned above, our work on "value of information" may lead to tools to compare investment decisions on infrastructure. Specifically, we should be able to evaluate the effect of adding sensors and networking to warn approaching vehicles. On the other hand, our investigation on indecisive pedestrians is a modeling and simulation study and its effects are longer term. It will lead to better understanding of pedestrian (and possibly other VRU) behavior and future reduction of risk, based on new technology.

Outcomes/Impacts:

The above may be considered as answering a very useful question like: "When is it worth municipalities to invest in additional camera-based infrastructure to help connected vehicles?" Both time optimal and fuel optimal traffic flow, for either individual Connected AV's or total Connected traffic throughout a time span will be considered and multiple scenarios inspired by ISO standard 22737 section 3.1 will be generated. This approach will also help identify critical challenges related to Vehicle to Infrastructure (V2I) communication,