Collision avoidance framework for autonomous vehicles under crash imminent situations

Runjia Du, Sikai Chen*, Yujie Li, Paul Ha, Jiqian Dong and Samuel Labi

Researchers and practitioners express cautious optimism that vehicle automation will finally solve the persistent problem of roadway accidents. However, researchers have found that in the practical application of AV technology, some ambiguity exists regarding the crash-reduction efficacy of AVs, particularly during the mixed-traffic era where both AVs and human-driven vehicles (HDVs) populate the roadway. There is concern that AVs operations may rather exacerbate crash likelihood in most situations. This concern arises from the possibility that AV-control algorithms may be inadequate, which is a serious concern in the AV transition period where AVs will share the driving environment with HDVs.

This presentation describes an ongoing research that is expected to help address this issue. We are designing an AV crash avoidance framework to guide the AV operations while reducing the likelihood of collision with surrounding vehicles, particularly where the traffic stream includes aggressive HDVs characterized by great uncertainty in their driving behavior. At least two collision avoidance strategies are being investigated: acceleration and deceleration to avoid rear-end, forward and side impact collisions.

We recognize that in very recent literature, designed AV control algorithms tend to take an extremely conservative approach towards addressing the uncertainties associated with surrounding HDVs; this leads to severe operational inefficiency. Therefore, our proposed framework will balance the conflicting objectives of operational efficiency and safety. This is being done by using joint decision-making protocols and sharing of real-time information that is made available via vehicle connectivity.

In addition, unlike most literature that discuss or address protecting the surrounding human drivers and pedestrians from errant AVs, the proposed research focuses on controlling the AV’s maneuvers in order to protect it from human drivers who drive recklessly, thereby facilitating the safety of the entire traffic stream. To facilitate deployment, we intend to validate the efficacy of the designed framework first using a driving simulation environment and then on a small test track at Purdue. The goal of these lab and field tests will be to demonstrate the safety enhancing benefits of the developed framework.

Presented by the Principal Investigators (Sikai Chen and Samuel Labi)