Horus: Using Sensor Fusion to Combine Infrastructure and On-Board Sensing to Improve Autonomous Vehicle Safety

Seshan, Sanjay (School: Fox Chapel Area High School)

Studies predict that demand for autonomous vehicles will increase tenfold between 2019 and 2026. However, recent high-profile accidents have significantly impacted consumer confidence in this technology. The cause for many of these accidents can be traced back to the inability of these vehicles to correctly sense the impending danger. In response, manufacturers have been improving the already extensive on-vehicle sensor packages to ensure that the system always has access to the data necessary to ensure safe navigation. However, these sensor packages only provide a view from the vehicle's perspective and, as a result, autonomous vehicles still require frequent human intervention to ensure safety. To address this issue, I developed a system, called Horus, that combines on-vehicle and infrastructure- based sensors to provide a more complete view of the environment, including areas not visible from the vehicle. I built a small-scale experimental testbed as a proof of concept. My measurements of the impact of sensor failures showed that even short outages (~1 second) at slow speeds (~25 km/hr scaled velocity) prevents vehicles that rely on on-vehicle sensors from navigating properly. My experiments also showed that Horus dramatically improves driving safety and that the sensor fusion algorithm selected plays a significant role in the quality of the navigation. With just a pair of infrastructure sensors, Horus could tolerate sensors that fail 40% of the time and still navigate safely. These results are a promising first step towards safer autonomous vehicles.