Top Level Newsletter: Connected Vehicle

(Published by IEEE Orange County Section)

February 2022
Volume 26.0

Editor-in-Chief: Kay Das, IEEE Life Member,
Systems Research Development and Innovation

Vol 26 comprises the following single topic:
(1) Have We Underestimated the Challenges With Automation?

We again wish our readers a Connected New Year! This issue will feature a single topic and pose some questions on the path to automation of connected vehicles..

General Notes

This series of newsletters is intended to provide the IEEE member with a top level briefing of the many different subjects relevant to the research, development and innovation of the connected vehicle.

The objective is to provide a platform for fast learning and quick overview so that the reader may be guided to the next levels of detail and gain insight into correlations between the entries to enable growth of the technology. Intended audiences are those that desire a quick introduction to the subject and who may wish to take it further and deepen their knowledge. This includes those in industry, academia or government and the public at large. Descriptions will include a range of flavors from technical detail to broad industry and administrative issues. A (soft) limit of 300 to 600 words is usually set for each entry, but not rigorously exercised.

As descriptions are not exhaustive, hyperlinks are occasionally provided to give the reader a first means of delving into the next level of detail. The reader is encouraged to develop a first level understanding of the topic in view. The emphasis is on brief, clear and contained text. There will be no diagrams in order to keep the publication concise and podcast-friendly. Related topics in the case of Connected Vehicle technology, such as 5G cellular and the Internet of Things will be included. The terms Connected Vehicle and Automated Driving will be used inter-changeably. Articles from other published sources than IEEE that add to the information value will occasionally be included.

This newsletter forms part of the regional Advanced Technology Initiative (ATI) of which connected vehicles form a constituent part. Technical articles solely from IEEE journals/magazines are referred to by their Digital Object Identifier (DOI) or corresponding https link. The link for each article is provided. Those

readers who wish to delve further to the complete paper and have access to IEEE Explore (www.ieeexplore.ieee.org) may download complete articles of interest. Those who subscribe to the relevant IEEE society and receive the journal may already have physical or electronic copies. In case of difficulty please contact the editor at kaydas@mac.com. The objective is to provide *top level guidance* on the subject of interest. As this is a collection of summaries of already published articles and serves to further widen audiences for the benefit of each publication, no copyright issues are foreseen.

Readers are encouraged to develop their own onward sources of information, discover and draw inferences, join the dots, and further develop the technology. Entries in the newsletter are normally either editorials or summaries or abstracts of articles. Where a deepening of knowledge is desired, reading the full article is recommended.

1. Have We Underestimated the Challenges With Automation? , Katrin Sjoberg

Published: IEEE Vehicular Technology Magazine (December 2021, Volume 16, Number 4, pp 99-102)

Human Error and Accidents

There is an interplay between human drivers and vulnerable road users in urban scenarios that is challenging for autonomous vehicles to capture.

The research shows that over 90% of all accidents are due to human error. Automated vehicle technologies hold the promise of decreasing the number of accidents. However, accidents are complex and usually there is a chain of events leading up to an accident. For example, take a signalized intersection, where a pedestrian enters the crosswalk against a red light when the traffic light turns green for vehicles. Vehicle A (across the intersection) detects the pedestrian and it drives slowly, crossing the intersection. Vehicle B behind Vehicle A changes lanes due to the unprecedented low speed of Vehicle A, and in the new lane Vehicle C coming with higher speed from behind cannot avoid hit ting Vehicle B. The root cause of this accident is due to a pedestrian not following the traffic rules. A chain of unfortunate events takes place due to this. The root cause of an accident is in many cases just like in the example. Vehicle B does not know why Vehicle A is driving slowly (e.g., it could be due to a faulty vehicle). When the police arrive at the scene, only Vehicle B and Vehicle C will be left, and Vehicle C will be held responsible for the accident due to the rear end hitting of Vehicle B.

Vulnerable road users are downright vulnerable in all types of road traffic situations. They are unpredictable in their behaviors for on board sensors such as cameras, radar, and lidar. In crowded places with many pedestrians and bicyclists, automated vehicles are struggling to make decisions without being too conservative, annoying passengers. There is an interplay between human drivers and vulnerable road users in urban scenarios that is challenging for autonomous vehicles to capture. There are also many situations when a human driver avoids accidents. The research is poor on the non-collision

rate for human drivers. How skilled is the human driver in reality? And how many accidents are avoided because of the interplay between drivers and other road users?

There is one technology that is very underutilized in the context of autonomous driving: vehicle to everything (V2X) communication. V2X communication entails vehicle to vehicle and vehicle to smart road infrastructure communication but also vehicle to pedestrian. Onboard sensors such as radar, lidar, and camera are line of sight sensors unable to see beyond physical barriers and they are affected by heavy rain and snowfall. Furthermore, they cannot predict the intentions of other road traffic participants. V2X, on the other hand, can “see” beyond physical barriers and provide the intention of others, which is very powerful in the context of autonomous driving. It complements and extends the range of the onboard line of sight sensors. V2X is pivotal for automated vehicles, but despite this, none of the major companies working on self driving technologies is using or promoting it. There is a chicken and egg problem with V2X communication; benefits will increase with technology penetration. However, this sensor is cheap compared to other onboard sensors with their advanced signal processing.

There was a notification for proposed rulemaking (NPRM) for V2X communication in the United States, which did not make it through the legislative process before Donald Trump entered the White House. When Trump exercised the two for one rule, the NPRM was stalled. The legislation proposed that all passenger cars (<3500 kg) were to be equipped with V2X communication. A similar legislative proposal was present in Europe but was stopped due to heavy lobbying during the summer of 2019. There was a made up narrative that V2X threatened the rollout of 5G networks, which could not be further from the truth since V2X and 5G complement each other. The major difference between the legislative proposals in the United States and Europe was that in the latter case it was an option.

Tesla has experienced three road deaths when customers have used the autopilot functionality where at least two of them could have been avoided if V2X communication had been in place. These two accidents are similar; a truck makes a left turn and crosses the lane where the Tesla is coming, which in turn misinterprets the situation, crashing into the truck trailer combination. If V2X had been used by the involved vehicles, the Tesla cars would have “detected” the truck in front of it and slowed down or, alternatively, the truck– trailer combination would have received information about the speed of the oncoming Tesla and could have waited with the left turn.

Ad hoc V2X communication is essential for automated vehicles and 4G/5G connectivity is important. V2X communication solves tricky traffic situations, complementing the on board line of sight sensors. The first patent on V2X communication was filed in 1923 by Harry Flurscheim:

The present invention relates to radio warning systems for use on vehicles intended to permit a vehicle to signal its presence by means of electric waves to all other vehicles in its more or less immediate vicinity.

If Flurscheim’s invention had been commercialized a century ago, then V2X would be as common as the steering wheel, brakes, and gear box.

Autonomous Vehicles

Tesla Abandons Radar

Tesla has once again surprised the industry and the general public, this time by abandoning radar and only relying upon eight camera sensors mounted on the vehicle for its autonomous functionality. In May of this year, the models Tesla X and Tesla 3 were placed on the U.S. market without radar. Tesla has stated that advanced image processing has now made radar obsolete. Several experts in the industry have reacted to this decision as they still believe that radar is a must have for automation. The response of *Consumer Reports* to this was to remove the "top pick" label for the affected models, and other ratings have also decreased. Some critics say that the radar drop is due to cost cutting, and by only using a camera system, situations like driving when it's dark, under poor weather conditions, and in sunny glare will for sure be more challenging. On the contrary, radar of course has its drawbacks such as classifying static objects and vehicles that are perpendicular to the driving direction such as truck–trailer combinations. None of the news flashes about this topic mention another very critical piece for fusing data from different sensors in real time, namely time synchronization. Lidar, cameras, and radar need to be very tightly synchronized to make relevant decisions about the surroundings.

Wrap-Up

Waymo was the first company to announce the intention of bringing self driving technologies to public roads. They began their journey in 2009 under the notion of Google's self driving car project. This was over a decade ago. Currently, they are operating a taxi service in Arizona that opened to the public in 2020. It is the first commercial taxi service without a safety driver. The vehicles can travel in speeds up to 45 mph. There are still tricky traffic situations that the taxis have difficulties in handling; this has been reported in the press, such as when there are many pedestrians present or traffic cones. Google is leading the world in the field of data processing, collecting excellent experts, and they have developed taxi service in a pre-defined area under nice weather conditions during the last decade. This is, of course, a major milestone and should be acknowledged, but this also reveals the challenges inherent with automation.

There is a naiveté in the tradition al automotive industry regarding autonomous driving and the time it will take to place Level 4 vehicles on the market. Automakers try to accelerate their plans for bringing automation to the roads by having strategic collaboration with start ups developing self-driving tech-nologies. However, automakers have not been working for over a decade on automation like Google.

One of the drivers for automation is the potential reduction in accidents and fatalities, as mentioned earlier. Over 90% of all accidents are caused by human drivers, but what is the non-collision rate for drivers due to the human brain's capability to determine contexts in a split of a second and due to the interplay between drivers and other road users? The enchantment of this number dazzles what new types of accidents that will occur or if really all accidents can be ad dressed by automation.

Automation will, of course, play a role for the future for moving goods and people in a safer and more secure way, reducing environmental impact. However, the timeline needs to be revised and challenges need to be acknowledged. Connectivity also needs to be accepted as a natural ingredient for facilitating automation. Connectivity is a powerful “sensor,” bringing information that cannot be achieved with other onboard sensors, especially ad hoc V2X communication that can within milliseconds “see” beyond physical barriers and receive intentions by other road users, extending the in formation horizon.

To summarize, the projected launch of autonomous vehicles is years behind because challenges are greater than expected. Are we solving the right problems and pain points with automation, or are we developing technology for technology’s sake? Automation is an evolution and not revolution, manually-driven vehicles will be operated alongside automated vehicles for the foreseeable future on public roads. Furthermore, automation is one tool in the toolbox for making the world cleaner and safer, together with electrification and ITS. (1568 words)

DOI: 10.1109/MVT.2021.3115873