

Discussion on Freight Mobility, Connected Vehicles and Cognitive Autonomy

Good afternoon. I wanted to thank Neil and the team at TRB for their invitation and opportunity to speak with you today.

We have seen incredible technological advances in the last decade. The record is pretty clear that technology has made our lives better in domains beyond physical mobility. Telecommunications, remote sensing; genetic engineering, the Internet, of course; and even advanced medical prosthetics are a few examples.

It will surprise none of you that a key thread common to these advances is computing power. We take the yearly increase of computing capability for granted. And, if you are like me, you often wonder what the next great revolution will be that computing power will enable.

Apart from computing power, there have been several other developments that set the stage for this new age of vehicle connectivity and autonomy. GPS is certainly one. Today, measured in inches – or less – GPS has proven instrumental in the advancement of this technology.

Another critical advance is the explosive growth of sensor technologies and, concurrently, the miniaturization of those sensors. And because they are so small, a sensor for every conceivable function or eventuality can be inexpensively integrated into just about any connected or autonomous system.

But increasing computing power, GPS, and sensors, are simply not adequate by themselves to enable what we see on the horizon. The real potential transcends simple connectivity or autonomy and lies instead in cognitive autonomy.

Systems engaging cognitive autonomy operate using the actions we would expect from the judgment and ultimately, the ethics of a human being performing the same function. Let me explain.

As you know, there are many companies here in the U.S. and around the world that are working to develop driverless cars. The general public might assume that it's not that tough a problem. GPS, combined with the right sensors and control standards, will keep the vehicle on course, and will ensure that it doesn't hit the car in front of it. Sounds simple, right?

Discussion on Freight Mobility, Connected Vehicles and Cognitive Autonomy

But let's say a person runs out in front of that vehicle. And let's say that car is moving too fast to stop in time. Now the car needs to figure out which direction to swerve to avoid hitting the person. And let's say that if the car swerves to the right it risks hitting other people on the sidewalk. But if it swerves to the left, it risks hitting on-coming traffic.

The systems controlling that car need to prioritize the risks, evaluate the potential harm of each option, and act on those evaluations. They need to do it instantly, and the results must be at least as good every time as one would expect from the best human driver. And hopefully, the results would be better.

However you want to think about it, the actions of an autonomous vehicle must reflect the same concern for human life as a human driver. That's cognitive autonomy. And ideally, such a vehicle would be able to act without a human's judgment lapses or execution inadequacies. That's a much bigger problem than can be solved by a GPS receiver and a set of sensors, as critical to the solution as they are. But this is where this revolution begins, because it's a much bigger challenge than can be solved by computing power alone.

So, before I go any further, let me address a misconception – an understandable one, but a misconception nonetheless. Many non-technologists presume that technology is constantly progressing with analytical continuity, where future results simply build on the results of the past. We all understand Moore's Law – that processing speeds have doubled every eighteen months or so. And I think this is one reason why so many take technology's progress for granted. It is easy to presume that any computing-based problem can be solved if we are just willing to wait for Moore's Law to catch up to our ambitions.

But the development of cognitive autonomy is different. It isn't just about the progression of hardware capabilities, so the necessary breakthrough could not come from the simple advancement of computing power. Something else is required – something that would allow a machine to learn. That something turns out, of course, to be algorithms.

Discussion on Freight Mobility, Connected Vehicles and Cognitive Autonomy

We are almost to a point where it is easier to include the algorithms necessary to allow a machine to learn, than it is to attempt to program an action for every contingency. That represents a tipping point; a line of demarcation beyond which it makes sense to pursue machine learning.

In Wyoming, this is where we begin. Focused on safer and more efficient movement of freight through one of the most physically challenging places in our country, we are taking some initial steps towards large scale utilization of cognitive autonomy by installing connected vehicle technology within Wyoming's surface transportation infrastructure.

Along with our private sector and USDOT partners, we are bringing together an integrated traffic management system, our state-wide 100 gigabit data rings, advanced sensors and algorithms to deploy the first wave of roadbed communications that live-connect freight haulers.

Interstate 80 runs 400 miles along the southern edge of Wyoming and is a vital east-west connector for freight and passenger travel across the country. The corridor averages more than 32 million metric tons in hauled freight each year. The truck volume alone can be 70 percent of the traffic stream.

Wyoming's notorious winds result in some of the nation's most severe weather events and greatest concentrations of vehicle accidents involving freight. In one year, more than 1,600 crashes on this small stretch of I-80 resulted in 271 injuries and 18 fatalities. The economic impact of these crashes topped \$865 million.

The Wyoming Connected Vehicle project is deploying advanced dedicated short-range communication applications ... leveraging vehicle-to-vehicle and vehicle-to-infrastructure connectivity.

The platform supports a range of initial services such as: pushed advisories; distant-forward collision warning; situational awareness; work zone warnings; weather impact warnings; and distress notifications. Occurring collectively and in real-time, the information is articulated within freight hauling and other vehicles, including those used by highway maintenance and emergency responders.

Discussion on Freight Mobility, Connected Vehicles and Cognitive Autonomy

Designed to be interoperable and replicable in other parts of the country, the installation will significantly reduce the number of crashes, road closures, injuries and fatalities. A parallel project to enable safer, more informed operation of autonomous vehicles on Wyoming's roadways, particularly on Interstate 80, will also be developed on this platform. This highly instrumented corridor will be a national-level research environment, and allow us to further refine autonomous vehicle use in some of the most challenging weather and driving environments imaginable.

There is a lot riding on this moment. Personally, I am very excited by it. This application stands to enable enormous progress in safety and mobility. But it also stands to allow policy-makers and engineers to take the knowledge afforded them by the information age, and translate it into the actions necessary to benefit all of us. It's hard to imagine something more exciting than that.

Thank you again for the opportunity to be with you today.