

# The Coming Digital Pavement-Vehicle Interface



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A lot has been written about the pavement-vehicle interface. We can easily measure skid resistance using a skid-trailer resulting in useful data about the pavement. Over time, we can see these results change due to polishing of the aggregates, wear of the asphalt (binder) coating on SMA mixes and so on. Sometimes it improves, sometimes not. The data can help us determine when to apply a surface treatment to improve skid resistance.

Other pavement-vehicle interface issues include ride vibration and noise generation; each with its own parameters and attributes. We can measure each of these and considerable research has been published on how to achieve a smooth (but skid resistant) pavement while attaining a low-noise surface. These attributes make asphalt pavements very desirable in urban areas.

## *Digits? A whole new chapter*

Autonomous car discussion is all the rage in our industry today. It's hardly a new topic. Cars developed by Mercedes-Benz in 1987 and just earlier at Carnegie Mellon University in the early 80's were truly autonomous and usually receive credit for being the first of the type. Since then, the race is on with non-traditional automobile manufacturers such as Google and the usual cast jumping into the fray.

It makes for exciting headlines such as "Google's Self-Driving Cars: 300,000 Miles Logged. Not a Single Accident Under Computer Control." (The Atlantic, Aug 2012), and "Doing the school run just got easier! Nissan unveils new car that can drive itself on short journeys." (Daily Mail, Feb 2013). We live in exciting times.

Autonomous cars rely on multiple sensors and elaborate algorithms to collect and analyze data to control the vehicle's operation. It's not so easy. A quick view of some of the test footage makes for interesting viewing; the curious bicyclist who wanders around the vehicle confusing the software as to what to do; the ball which comes into view soon followed by the child; double train tracks, cross traffic and a pedestrian crossing; poor roadway surfaces without readily discernable edges. The list goes on. With each decision "infraction" of the test vehicles, the software engineers write some more code.

Yet for all of these issues, the vehicles are steadily making their way into our environment. Consumers can purchase a somewhat automated car today. Tesla's vehicles all have the capability to drive with conditional automation and claim to do so at a safer standard than a human driver can. I've driven and been transported via their auto drive in several and the capability is impressive. Many US manufacturers now offer efficient self-parking features. No more trouble with the parallel parking challenge!

Several states in the US now have autonomous vehicle laws enabling full scale testing of the ultimate; start to stop without driver input. Would you get into a car without a steering wheel? It is likely in our future. We get into trains and other people movers today without an operator – all the time.

Freight companies are in long range testing of heavy trucks; fully controlled autonomously yet equipped with a driver monitoring the performance of the digits. Imagine loading a truck with goods in Milan and sending it to Madrid without a driver. It will park at the loading dock too. It's coming.

Futurist Michael Rogers proclaims that it may one day not be legal to drive a car – it will simply be too dangerous. We'll have to let the autonomous vehicle take us to our destination. So much for VW's fahrvergnügen.

For those of us in the transportation business, and specifically delivering infrastructure that meets today and tomo-

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row's transportation network needs – what does this all mean? It depends on what we're talking about.

For the single autonomous vehicle, operating at one of the lower to mid-level of SAE autonomy definitions, probably not much. The average age of a US based car is about 15 years. So even as fully autonomous vehicles hit main street, most of the vehicles they will have to interact with will be dumb cars. It is going to take some time before the majority of vehicles are autonomous. It will be an evolutionary change.

For safety, proof of concept, and insurance reasons, we may end up having autonomous or self-driving only zones – and our industry will have to build them or modify existing roadway lanes to accommodate this new requirement. These vehicles could end up traveling in platoons; closely following each other at the exact same speed; the interconnectedness of the vehicles making it possible to brake and accelerate simultaneously.

The interconnectedness of vehicles brings new requirements, one that is being studied at places like Ohio's Transportation Research Center under a \$40 million U.S. Department of Transportation program evaluating how data, technology and creativity will shape how people and goods will move in the future. Wifi access, enabling the interconnectedness of things, is just one of the infrastructure pieces being looked at.

Perhaps the limited battery life of electric vehicles will be solved via "charge in motion" infrastructure enabling recharging without stopping. This requires lane technology which

our industry will have to accommodate. Another plus for asphalt pavements; the easy of adaptation of these new technology features within the existing infrastructure is clearly an asphalt advantage.

Our US Federal Highway Administration has spent some time thinking about what this all means from insurance and liability, to data ownership and sharing, to vehicle safety and design. They've published a "Federal Automated Policy – Accelerating the Next Revolution In Roadway Safety" as a start. It is an insightful read into what's coming. The table below, excerpted from their publication, shows the levels of thinking already underway (HAV by the way stands for "Highly Automated Vehicle"):

It is an interesting approach to the autonomous vehicle's arrival on the transportation network scene

Looking at the table you'll see "Ethical Considerations." Imagine traveling down a residential street at or below the speed limit when a child pops out between two parked cars chasing after that rolling ball. The autonomous car knows it cannot stop in the distance provided. Does it steer to hit the child or veer onto the opposite sidewalk with pedestrians? What would you do? These and many other considerations must be solved for socially acceptable autonomous car behaviors to integrate into our human society.

Until then, our infrastructure must and will adapt to support these new transportation providers, as our paths, trails and dirt byways did in the last century to support the introduction of the horseless carriages of the mid 1800's. With asphalt, we can quickly and economically adapt our infrastructure meet the needs of what promises to be an interesting evolution in our transportation networks.

