Urban Dynamics Institute & Climate Change Science Institute

Connected and Automated Vehicles (CAVs) Leveraged to Enhance Efficiency

Recognition of the necessity for connected and automated vehicle (CAVs) is gaining momentum. Many stakeholders intuitively see the benefits of multi-scale vehicle control systems and have started to develop business cases for their respective domains, including the automotive and insurance industries, government, and service providers. The question is whether we could take advantage of connected vehicle technologies and optimize transportation efficiency in addition to safety. There is a solid body of research available that has aimed at enhancing our understanding of vehicle system optimization. However, the biggest remaining uncertainties are related to external factors including the driver's driving style and the surrounding traffic environment. It appears that research needs to be devoted to considering the vehicle as part of a larger system, which can be optimized through connected vehicle technologies at an even larger scale. Such larger-scale optimization will require the acquisition and processing of additional information from the driver and conditions outside the vehicle itself.

Oak Ridge National Laboratory is addressing this problem by considering overall optimization of CAVs that will aim at overcoming the uncertainties related to external factors including the driver's driving style and the surrounding traffic environment. Our concept hinges on the idea that in the "new world" of massive amounts of data from vehicles and infrastructure, what we used to model as uncertainty becomes additional input or extra state information in a much higher-dimensional vector. The **overarching goal** of this research effort is to establish a rigorous optimization framework and develop decentralized control algorithms for online coordination of CAVs with the aim to improve traffic flow and vehicles' fuel consumption and emissions. If vehicles can coordinate with each other and communicate the most appropriate vehicle speed, or route, through driver information systems to the drivers (Figure), stop-and-go driving and idle engine operation will be avoided with significant implications in energy savings for the transportation network.

The potential benefits of this research approach are substantial. Overall operation of the transportation network can be improved in terms of alleviating congestion, reducing energy use and emissions, and improving safety. The vehicles will no longer operate in isolation and will integrate external data being considered as part of a whole.

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