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Editorial

Special Issue on "The Social Car: Socially-inspired Mechanisms for Future Mobility Services"

1. Introduction/motivation

Internet and social network services provide a basis for cars to share various types of information, such as driving-relevant information (traffic or road condition, vehicle status, or navigation information), and even driving-irrelevant information (music or video pieces, passenger interactions, driver's feelings or mental status, etc.) with other "interested" cars or the urban infrastructure. Given that the current amount of cars on the road worldwide is higher than the number of active users of social network services, the potential for socially-inspired mobility services is enormous. To give a few examples, socially-inspired traffic could converge to the long term traffic safety goals of zero death on our roads. It is further assumed that concerted driver behavior allows for improvements on sustainability (efficient, fuel-saving driving), and that concepts such as autonomous driving or traffic shaping (e.g., with adaptive lanes) results in increased satisfaction and pleasure of driving experience. Other expected improvements relate to social forgivingness (limited willingness to anticipate a potentially unsafe action), enhanced self-assessment, or a better prediction of upcoming traffic situations.

In the long tradition of driver–vehicle interaction, however, information systems have been socially ignorant—they have not accounted for the fact that drivers' (humans') emote all the time and decisions are always socially inspired. The next-generation automotive interfaces need to include the essence of social intelligence to become more effective and safer. Therefore, it is to be questioned why not, for example, should the 'car' relieve the 'driver' by taking over some tasks and accomplishing them as efficiently as the human driver by an application of social intelligence?

This special issue aims at discussing the potential of cars' socializing with one another (similar to how humans are socializing with others) or the urban infrastructure. With the introduction of the concept of "socially-inspired mobility services", we attempt to make a blueprint of the next generation in-vehicle technologies. This is different from what the Internet of things (IoT) community is talking about in the sense that IoT is sufficient if it has its own ID that could be passively identifiable. In contrast, social cars have more autonomous capability and thus, they could serve as a more active and even interactive social being. Further, we are not only interested in social interaction between drivers, but rather focusing on the automotive domain in its entirety as one field with huge potential on enabling social interactions.

2. Evolution of social interaction in traffic

Cars have become "smarter" during the last century, but still they are mindless and need to be controlled by an individual driver. Each and every driver has its own personality and the internal state of a driver may change due to different reasons from one moment to the next. This is, of course, a source of unpredictable and unsafe behavior. Legislatory regulations and traffic control can prevent danger caused by alcohol, drugs, and fatigue, but there are other sources that (temporarily) influence the normal competence of a driver that might not (yet) be detected reliably by technology (for example, stress, anger, or rage). Before establishing vehicle-to-vehicle or vehicle-to-infrastructure communication on broad scale, this safety critical problem needs to be solved.

For a very long time, automotive assistance systems (such as ABS, ACC, etc.) were operated in isolation in single cars and only with broad availability of wireless/mobile communication technology. First, V2V/V2X applications emerged. At this time, V2V/V2X applications were promised to offer huge potential regarding improvements in driving safety, comfort, and much more, but unfortunately, the services offered were either realized as manufacturer-specific applications that enabled remote inspection or phone-based control of the auxiliary heating system, or sharing of information and media or playing of network games or chatting between cars (which are not really useful to increase road safety). Nowadays, almost all of newly sold cars are connected to the Internet, and with it the transition from formerly independently acting drivers and cars

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to connectedness with 'the rest of the planet' has been completed. (Even if the coverage of wireless vehicle communication technology on a global scale is still some years away, this is mainly a technological issue and will likely happen.)

Looking on **global problems in road traffic** it is evident that traffic density and likelihood/duration of jams has considerably increased in the past decades. Together with it more drivers seem to feel increased stress and anger from traffic, and a lot of people cancel or postpone planned trips due to anticipated high traffic. These problems cannot be solved by merely adding another lane to the highway, building new roads, or pushing public transportation. A sustainable solution requires a holistic approach, including new ways of traveling (platooning, car- and bike-sharing, active mobility, i.e., walking, bicycling, etc.), concerted coordination, and proactive management of traffic. This can be achieved today by combining real time tracking data of vehicles, traffic flow sensing (sensors integrated into road bed, traffic cameras), and weather and event information, with analysis tools and simulation models to proactively control traffic and thus, keep people moving more efficiently or safely. By applying concepts like incentivization it is likely that the behavior of cars (or drivers) can be changed.

To force **safety**, V2V systems could, for example, take over control of a car moving inappropriately (i.e., the driver ignores a road situation or reacts too slowly) in a convoy by applying brakes. It needs to be argued, however, that a broad application of this auto pilot-like safety system might also be criticized by drivers as they would most likely not be willing to accept restriction in personal freedom. Traffic fully under control of computer systems and network communications also poses potential for criminal activities (central control can be (mis)used to induce mass collisions or to generate gridlocks from everywhere at the planet).

2.1. Service layers

2.1.1. Vehicle-to-Vehicle (V2V)

Today, about 1 billion of cars are in operation world wide and it is estimated that this will rise to more than 2 billion cars in 2030. Together with almost complete interconnectedness, this offers tremendous potential for services in the car centered around "social intelligence" or the ability of a system to understand and manage social behaviors. Socially behaving cars should create true value for the road participants, and not just post the social status (feelings) of a driver or provide status information of the car (and collect "Like"s) as Facebook does. In contrast, a socially-acting vehicle system should allow cars to automatically resolve conflicts in mass traffic, negotiate with each other, behave as a collective to optimize characteristics, such as driving time or efficiency (e.g., waiting time in traffic jams or road charge to pay), to address the topic of environmental protection (reduced CO_2 emission), to raise safety on the road by monitoring other cars' behavior in the vicinity, etc. More precisely, connected vehicles could issue warnings about potential dangers to other cars behind. Concerted deviation in the steering angle could, for instance, be used as an indicator of an obstacle (pot hole, object on the road). If a vehicle at some distance ahead applies the brake hard, a system alert can be issued to all the cars behind to avoid (mass) rear-end collisions and a "slippery road surface" warning could be relayed to all drivers in a certain region if at some point, e.g., on a bridge ahead, several cars have applied their brake during the past time (recognized by a sensor in the power brake unit) and at the same time the CAN bus provide information that traction was lost. Depending on the outside temperature this might have been caused by road ice or oil slick.

More provocative, a social car could require a social environment (for example, intelligent roads with dynamically changing lanes; road signs adapting to the driver, etc.) and social cars should have real social capabilities, such as "learning" (car automatically recommends alternative routes if having learned that there is a traffic jam every workday in that region at a certain time; such a behavior would be particularly relevant to drivers using a rental car in an unknown area), "forgetting" (for example, a vehicle moves more carefully after having been involved in an accident; however, the incident is forgotten after some time and avoids that the car is fearful and drive too slow in the long term…), or "remembering" (for example, a vehicle remembers from one winter to the next, that driving at or near the speed limit is not wise with temperatures below zero degrees or snow coverage on the road, etc.

2.1.2. Vehicle-to-Infrastructure (V2I)

Looking on potential applications in V2X/C2X, cars, pedestrians, and traffic/pedestrians lights could autonomously optimize themselves by exchanging information, such as "throttle down, red light ahead", "attention, pedestrians intend to cross at the crosswalk" or "don't make a turn; oncoming traffic is too fast", etc. Also, a type of of "smart road concepts" should be possible with such an approach, e.g., allowing dynamic reconfiguration of the road network by changing lanes per direction inbound/outbound depending on time of day or road usage (necessitates augmented reality instead of road paintings). In addition, adapting the maximum allowed speed based on the context, would be a feasible approach for a "smart sign concept": Signs could display reduced speed limit on an approaching novice driver or increase the limit when a professional driver is close-by. An "overtaking denied" message is likely to pop up on a detected lorry or jam, etc. in the curve ahead and a "overtaking permitted" message can be shown on the sign even on poor visibility if no other car is detected in the overtaking area.

2.1.3. Vehicle-to-Business (V2B)

The automotive industry has traditionally developed Vehicle-To-Business (V2B) use cases related to road-side assistance, navigation, concierge and infotainment services. These services can be provided by specialized third party telematics