Editorial

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Today, in the era of Industry 4.0, automotive technology is advancing at a very rapid pace. Vehicles are being equipped with increasing numbers of mechatronic components, initially functioning as driver assist systems, then evolving into what is termed as advanced driver assistance systems (ADAS), which provide some level of automated and autonomous decision-making capabilities. ADAS equipped production vehicles with level 2 vehicle autonomy is not uncommon today, and advancement into level 3 autonomy appears to be imminent. Audi had initially earmarked the 2019 A8L model to have this level of autonomy, only to have the plan abandoned later, seemingly due to problems with regulatory authorities (Alaniz, 2020). Meanwhile, Honda has set March 2021 as the starting date for mass production of their level 3 autonomous vehicles (Reuters, 2020).

Advances in vehicular technology seek to improve key issues such as safety, environmental protection, passenger comfort and driving performance. Understanding vehicle dynamics under various driving scenarios is a key to the development of improved control strategies capable of avoiding instability conditions, which then allows for vehicle performance to be pushed to higher limits, while improving safety and comfort, and minimising negative effects to the environment. To execute such control actions requires the fusion of technologies from mechatronics, internet of things (IOT) and artificial intelligence, creating a cyber-physical vehicle system (CPVS). A CPVS can be regarded to comprise of locomotion, computational and communication components that are strongly interconnected. The development of CPVS is largely attributed to advances in research on autonomous vehicles (Bradley and Atkins, 2015).

This special issue contains a collection of selected papers from the ReCAR 2019 conference held on 20–22nd August 2019 in Bangi, Malaysia. ReCAR is a series of conferences held biennially since 2011, focussing on developments in automotive and vehicular transportation technology. About 80 papers in total were presented at ReCAR 2019. Extended versions of papers on vehicle mechatronics and related topics were solicited for submission to this special issue. The extended papers were then subjected to further reviews, and in the end, a total of six papers were accepted for publication.

In the paper 'Simulation with car-following model considering vehicle dynamic features', car following behaviour was studied through simulations, where the vehicle dynamics were taken into consideration. This provides an insight into the driving behaviour of different vehicle types in traffic. Of particular significance is in the fact that hybrid and full electric vehicles display significantly different dynamic characteristics compared to internal combustion engine vehicles, especially in start-stop traffic.

Automotive vehicle suspensions function to perform both ride comfort and vehicle handling ability. However, these dual roles demand conflicting damping and stiffness characteristics. Active and semi-active systems have long been studied to improve suspension performance. In 'Handling performance criteria evaluation for vehicle suspension system with semi-active control strategies', it is pointed out that semi-active suspension design strategies have concentrated on optimising the ride comfort characteristics. This paper presents a study on the handling performance of semi- active suspensions, when designed using established ride comfort optimisation methods.

Focus changes from civilian to military vehicles in the next paper, entitled 'System configuration of instrumented half-scaled armoured vehicle to enhance handling performance due to lateral firing impact'. Here, the problem of unwanted yaw moment due to gun recoil during firing is discussed. An armoured vehicle with a mounted heavy gun is subjected to large recoil forces when the gun is fired. If the firing is in a direction that is not parallel to the longitudinal direction of vehicle motion, the lateral component of the recoil force could produce a yaw moment that would result in a deviation of vehicle trajectory. The authors then proposed the yaw disturbance rejection control scheme as a solution to improve the armoured vehicle handling performance while firing at an angle on the move.

Driver fatigue leads to human driving error and accidents. However, deciding when one is too fatigued to drive safely may not be straight forward. A support system that could perform this decision may be very useful in improving road safety. In 'Designing a graphical user interface for the decision support system of driving fatigue', a guided user interface (GUI) was developed to help in this decision making computing process. The GUI requires some information to be entered by the user, then a decision on the level of fatigue is determined via a fuzzy inference system.

Improper control of automotive electro-mechanical friction clutches (EMFC) could result in engine stall, excessive jerky motion, increased drivetrain vibration and powertrain component failure. The problem is not straight forward as it involves a diaphragm spring with nonlinear characteristics. In 'Simulation of electro-mechanical friction clutch control using proportional derivative plus conditional integral control scheme for automotive application', the performance of several types of controllers in controlling the engagement and disengagement actions of an EMFC was studied through simulations.

Vehicle drifting is not only of interest as a hobby or a sport, but also in designing stabilising control strategies for improved safety. The dynamics of drifting motion of rear wheel drive vehicles was studied in the paper 'Vehicle drifting: mathematical theory and dynamic analysis for stabilised drifting of RWD vehicles'. A novel approach in analysing the drift manoeuvre was proposed, and a control strategy for transient drifting manoeuvres was formulated.

The six papers in this special issue all present studies related to automotive safety, comfort and performance. The studies are mostly concerned with the dynamic behaviour and control of automotive systems and subsystems, while one paper described a user interface for an artificial intelligence based decision support system for improving driving safety. While level 5 fully autonomous vehicles may still be some time away from realisation, vehicle mechatronic concepts is the key to achieving control actions required for autonomy at levels 1 to 5.

References

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