Research Diary

5G connected devices like smartphones, vehicles, and IoT devices (e.g., wearables) can avail the benefit of this service using an application running on these devices, which can request the location services required for the emergency services. The request, along with the associated location information, is sent to the ITS server via the 5G network. Additionally, the ITS application itself can request the user to provide its current location to enhance the emergency services response. Using this, the ITS application can assist the user in reaching a safe location at times when the user does not know where and how to reach a safe location.

Human safety, as well as the safety of materials, are vital and a necessary component of any armed forces organization. LCS with ITS can assist in close monitoring of the location of Infantry Fighting Vehicles (IFVs) and suspect the entry of intruders in the remote military/navy zones.

We have sample applications on ITS working using our testbed. The details of it can be availed from the recent demonstration we had at IEEE International Conference on Network Softwarization. https://youtu.be/wxirflvpTjc.

In addition to on-road transportation assistance, LCS can be quite useful in Ocean Networks, too, with a private 5G deployment, as illustrated in **Figure 12**. Offshore fishing is a common occupation providing a livelihood for tens of millions worldwide. Lack of timely warning can lead to missing fishing vessels, collisions between ships and boats during night times, bad weather, lack of offshore communication resulting in late information/message arrival to their families, and so on. In this regard, a 5G-based LCS system can assist in building a maritime safety information communication system, tracking fishing vessels with the fishing vessel to shore (V2I) and fishing vessel to vessel communication (V2V), Maritime IoT, and local community network for fishermen.

The observance of 'safety first, safety always' is intended to strengthen the professional approach to enhance combat capability. It also strongly aligns with the Digital India initiatives and is a key driver for economic growth and technological development in India, and we are more than glad to have played a role in it.

Figure 12: LCS assisted IFVs & Ocean Networks using Private 5G

Research Diary

Heterogeneity in the Driver Behavior: An Exploratory Study Using Real-Time Driving Data

Dr Digvijay S Pawar (L), Assistant Professor
Ms Jahnavi Yarlagadda (R), PhD Scholar
Dept of Civil Engineering

KID: 20220204

Road traffic accidents are one of the leading causes of death, resulting in approximately 1.35 million deaths every year [WHO, 2018]. The factors associated with road crashes have been studied over decades, and driver behaviour is concluded to be the major contributory factor. Therefore, understanding the driver's behaviour is important for many applications like driver assistance or personalized feedback provision for enhancing driving safety, economy, and comfort. In addition, the implications of driver behaviour research are significant inputs for the design of autonomous vehicles. Driver behaviour indicates the manner of executing various driving tasks, which can be perceived as controlling the vehicle in the longitudinal and lateral directions.

The habitual way of performing driving manoeuvres is considered a driving style, which characterizes the individual driver or a group of drivers. Many researchers have attempted to classify the drivers and the driving styles based on the outcomes of driving tasks from the perspective of driving safety.

In this context, the study investigates the extent of variations in the individual's driving styles during routine driving. The driving styles are conceptualized using the vehicle kinematic data, that is, speed and accelerations performed during longitudinal control.

The data is collected for 42 professional drivers using instrumented vehicles over a defined study stretch. An algorithm is developed for data extraction, and a total of 7548 acceleration and 6156 braking manoeuvres and corresponding driving performance features are extracted. The driving manoeuvre data are analyzed using the unsupervised techniques (PCA and K-means clustering), and three patterns of acceleration and braking are identified, which are further associated with two patterns of speed behaviour. The results showed that each driver is found to exhibit different driving patterns in different driving regimes, and no driver constantly shows safe or aggressive behaviour. The aggression scores are found to be different among drivers, indicating behavioural heterogeneity.

This study's results demonstrate that drivers' level of aggression in different driving regimes is not constant, and characterizing the driver by means of abstract driving features is not indicative of diversified driving behaviour. The proposed method identifies the individualized driving behaviours, reflecting the driver's choice of driving manoeuvres, as shown in **Figure 13** & **Figure 14**. Thus, the insights from the study are highly useful for designing driver-specific safety models for driver assistance and driver identification.

Figure 13: (a) Instrumentation details; (b) Study vehicle; (c) Recorded speed and acceleration profiles; and snapshots of collected video data.

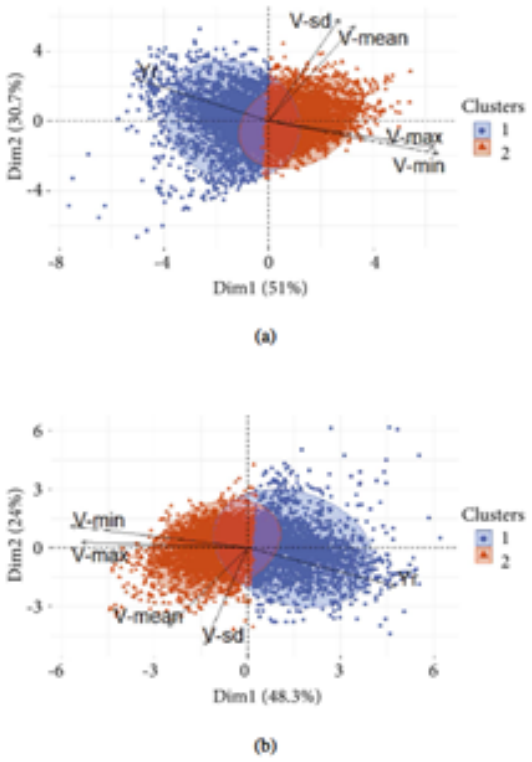

Figure 14: Cylindrical imperfection measured using DIC

Research Diary

Catalyzing Autonomous Navigation Design Thinking across India

Dr G V V Sharma, Associate Professor (R)
Dept of Electrical Engineering
Mr Chandrakumar Chettiar (CK) (L),
MD, CEO, Optimuslogic Systems (India) Pvt. Ltd.

KID: 20220205

Introduction:
Drone (UAV) is probably the most exciting and widespread innovation today. Whenever and wherever a drone flies, it always catches our attention and excites our imagination towards autonomous drones doing a lot of work for us.

As Indians, an autonomous drone does not surprise us, thanks to the "Pushpak Viman" mythology of Ramayana – A flying machine that can go anywhere on command on autopilot, originally belonging to Kubera, the God of Wealth, stolen by Ravana, and restored back to its original owner by Lord Rama as illustrated in **Figure 15.**

In modern times, it is Tesla that has shown the world how autonomous navigation can happen in the real world and it works. As the market grows, more and more vehicle manufacturers are adopting autonomous navigation and driver aids in some form or other.

TiHAN-IIT Hyderabad is on this mission to accelerate autonomous navigation space in India by creating an atmosphere of innovation, training new talent to understand and implement solutions, and encouraging companies and start-ups to use its facilities to build and test terrestrial and aerial autonomous navigation enabled products.

Figure 15: Pushpak Vimana - India's 1st Autonomous Drone