Intelligent Transport Systems

- The emergence of Intelligent Transport Systems has the potential to deliver significant safety, environmental and efficiency benefits for transport users.

- ITS will dramatically change the way we drive and the way we interact on the road with transportation industries experiencing a disruptive and transformative environment.

State of the Road A Fact Sheet of the Centre for Accident Research & Road Safety - Queensland (CARRS-Q)

THE FACTS

What are Intelligent Transport Systems?

- Intelligent Transport Systems (ITS) refer to the application of advanced technologies and communication systems to transport infrastructure and vehicles. This sector is currently experiencing rapid growth and advances. They are motivated by growing social costs of congestion and road trauma brought about by increased global motorisation and urbanisation.

- ITS include stand-alone systems such as:
  - in-vehicle systems - navigation, intelligent speed assist, railway crossing warning systems;
  - variable message signs;
  - automatic number plate recognition;
  - cameras to monitor security CCTV systems.

- ITS also include Cooperative ITS (C-ITS) wireless communications that integrate live data and feedback from a number of sources:
  - Vehicle-to-Vehicle (V2V) - intersection arrival, collision avoidance systems, and emergency notification systems; and
  - Vehicle-to-Infrastructure (V2I) - traveller information services, traffic signal and variable speed control, tolling and freight management.

- Autonomous vehicles (AVs) are becoming some of the most heavily researched automotive technologies. Automated, autonomous or self-driving vehicles (level 3 or above) operate without direct driver input to control the steering, acceleration, and braking and are designed so that the driver is not expected to constantly monitor the road. Not only are car manufacturers (e.g. Tesla, GM, Daimler) developing and testing AVs today, but so are internet technology companies such as Google (now Waymo), Baidu and Uber.

- V2V, V2I, and in-vehicle devices will generate Big Data which will result in new ways (when analysed) to inform/help drivers in the future.

- Driver acceptance and trust of AVs is a major concern for road safety researchers, who must ensure V2V and V2I technologies are delivered in a contextualized manner to reduce crash risk. Drivers will have to adopt a new way of thinking, as they relinquish control of their vehicle to automation as the way a driver interacts with their immediate environment will change.

- Full integration of AVs is not expected to occur until at least 2050[1], due to legislative, regulatory, ethical and data management challenges. There will be a long period where a mix of AVs and traditional vehicles will operate together on the road, which will bring its own set of challenges for road safety.

It is predicted that AVs could reduce road fatalities by up to 90%

The Australian context

- The National Road Safety Strategy 2011-2020 (NRSS)[2] is based on the "Safe System" approach and revolves around safe roads, safe speeds, safe vehicles, and safe people. It represents the commitment of federal, state, and territory governments to an agreed set of national road safety goals, objectives and actions. November 2014 saw the endorsement of the NRSS Action Plan 2015-2017[3].

- As part of that Action Plan, Austroads' Cooperative Intelligent Transport Systems project[4] is intended to ensure a required regulatory and operational framework is in place to enable the successful deployment and operation of C-ITS solutions in Australia and New Zealand.

- Also as part of that Action Plan, Austroads' Safety Benefits of C-ITS and AVs project[5], will investigate emerging C-ITS and automated vehicle systems and applications to assess potential safety benefits.

- During the 12 months ending October 2015, there were 1,271 fatalities on Australian roads. This represents a 5.2% increase from the previous 12 month period[6]. This figure does not take into account the substantial number of people severely affected by road crash-related injuries.

- ITS will therefore be invaluable to achieve the NRSS vision: "No person should be killed or seriously injured on Australia's roads".

- The Queensland Government is leading the nation in transport technology and ITS applications including CCTV cameras on motorways and arterial roads, car park guidance systems, automated flood warning systems, bus priority and passenger information, a heavy vehicle management system on the Pacific Motorway and e-toll. It has also announced the establishment of the Cooperative and Automated Vehicle Initiative (CAVI) to prepare for the emergence of advanced vehicle technologies onto Queensland roads.

CARRS-Q & ITS

- At CARRS-Q, we use the "Safe System" framework to study the road transport system holistically. Our three ITS research axes are Connected Automated Vehicles (CAV), Human Machine Interfaces (HMI)[7], and Behavioural Analysis. We capitalise on research progress in IoT, automated/connected cars, Deep Learning (Artificial Intelligence), a person's data acquisition (Quantified Self) and ubiquitous computing, to reduce behavioural uncertainties in transport.

- Our ITS multidisciplinary activities range from blue-sky research, such as exploring the use of EEG (Electroencephalography) signals to drive a car, to applied research such as the interaction pattern between the car driver and vulnerable road users, or to predict when a driver's vigilance will be significantly altered.
- ITS research activities are centered around:
  - ° the assessment and analysis of drivers' performance in a controlled environment (Advanced Driving Simulator) or open/closed roads; and
  - ° the modelling, implementation, and evaluation of different interventions, including future driver assistance systems or new railway crossing devices.

Research infrastructure

CARRS-Q has a broad range of research infrastructure, including:

- Advanced Driving Simulator (six Degree of Freedom 6DoF) featuring traffic and sensor simulator functionalities;
- OKTAL desktop simulator with driving console and Oculus Rift Virtual Reality integration, also capable of simulating driving an autonomous vehicle;
- Research vehicle equipped with technology such as Eye Trackers (FaceLab, SMI glasses), Multimedia Data Logger (Vigil Vanguard), Laserscanners (Ibeo), Lane Detection (MobileEye), and Head Up Display;

- A set of physiological sensors (EEG, heartrate, skin conductance monitors, accelerometers, etc.); and
- High Performance Computing (HPC).

CARRS-Q'S RECENT WORK IN THE AREA

- Toward automated enforcement at active level crossings in Australia[8]. This research informed policy to ensure that level crossing warnings operate before extended waiting times are experienced by motorists[9].
- CoopEcoSafe: A new cooperative, green and safe driving system[10].
- A multidisciplinary study on the prevalence and driver's perception of following too closely in Queensland[11].
- Risky Gadgets to the Rescue[12,13,14]. The developed prototype, CoastMaster[15], is a smartphone App that serves as an ambient speedometer and driving game display engaging drivers during speed limit changes.
- The Australian Naturalistic Driving Study aims to provide answers to some intractable, high priority road safety issues (CARRS-Q in partnership with Transport for NSW, NRMA Limited, Transport Accident Commission (TAC) and VicRoads)[16].
- A new performance model for IEEE 802.11p communications for CAV based on extensive empirical data collection[17,18].
- Evaluating the use of biometric technologies to prevent unlicensed driving[19]. Combining an electronic driving licence with biometric technologies (e.g. fingerprints or facial recognition) could help prevent suspended or disqualified drivers from using their car during their sentence period.

FUTURE DIRECTIONS

- The Cooperative and Automated Vehicle Initiative (CAVI)[20] to test cooperative and highly-automated vehicles on South East Queensland roads developed by Queensland Government. Co-funded by the Motor Accident Insurance Commission, it will be delivered with the support of a number of organisations including Department of Transport and Main Roads, iMOVE, and CARRS-Q.
- Understanding the impact of autonomous vehicles on behaviour and interactions will explore three issues:
  - ° Factors influencing driver choice of automated vehicle control;
  - ° Interactions between automated and manually controlled vehicles; and
  - ° Driver detection, recognition, and reaction to automated vehicle system failures.
- Good intention but bad judgment? A study of objective versus subjective driving performance will examine the level of disparity between motorists' self-reported and computerised driving assessments.
- The development and pilot of a driver-specific feedback system to improve taxi driver safety.
- An investigation of different road safety applications using an Unmanned Aerial Vehicle (UAV), including traffic and speeding measurements, cycling safety, survey of jay walking and railway corridors for trespassing, and detection of tailgating.

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