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The Institution of Engineers, Singapore

Transportation Systems Sub-Committee of the Railway and Transportation Technical Committee

present

Entering the Connected and Autonomous Vehicles (CAVs)

Date	: Friday, 9 February 2018
Time	: 9.00 AM to 5.00 PM <i>Registration start at 8.15 AM sharp).</i>
Venue	: SIT Auditorium SIT @ Dover, 10 Dover Drive, S(138682)
Fees	: IES Members = \$42.80/- per pax Non-members = \$85.60/- per pax <i>Fees includes GST, 2 tea break & lunch</i>
CPD/PDU	: 5 PDU for PEB PE (Approved) 5 PDU for IES C.Eng (Confirmed for all Engineering branches/disciplines listed in http://charteredengineers.sg/branches/).

Synopsis of the Talks

1. Full Mobility using Autonomous Vehicles towards Better Living

by Dr. Marcelo H Ang Jr, Ag Director, Advanced Robotics Centre, National University of Singapore

Easy mobility is an important capability to enhance the quality of all our lives. Self-driving cars provide mobility-on-demand anytime and anywhere. Besides the convenience, autonomous driving provides a safe and productive environment, and an efficient use of resources. This talk shares our research group's current activities in achieving mobility-on-demand using autonomous vehicles, in both pedestrian (malls, airports, parks, etc) and road environments. The current state-of-the-art will be presented together with current challenges and our approach to solving these challenges.

2. Cellular V2X – another supporting technology for Connected Vehicles

By Dr Yang Ming, Project Manager, Centre for Infocomm Technology (INFINITUS), Nanyang Technological University

V2x communications are critical components of the connected mobility of the future. Cellular V2X, developed within the 3rd Generation Partnership (3GPP) and designed to add extra Vehicle-to-Network communication mode, provides more futuristic use cases and enhances the overall in-vehicle experience. In this talk, some of the major technical advantages of C-V2X is introduced. These advantages are examined based on the practical use cases that has been defined in 3GPP standard.

3. Swarm of Autonomous Vehicles by Dr Roland Bouffanais, Assistant Professor, Engineering Product Development, Singapore University of Technology and Design

Swarm Robotics offers a promising approach to the development of a framework for Connected Autonomous Vehicles (AVs). Collectively moving AVs are known to be more than just the mere superposition of vehicles in movement. Moreover, connected AVs exhibit a high degree of complexity as compared to fixed connected systems. This is the consequence of the time-varying nature of their connectivity, as well as the fact that AVs are connected through a dynamic network that is embedded in space. We will present a platform-agnostic swarm-enabling technology, which can be integrated onto any fleet of AVs in order to get them to accomplish swarming behaviors. Two examples of such swarm of AVs will be discussed along with testbedding results obtained with units dynamically deployed over large surface areas of an uncontrolled environment without any supporting infrastructure.

4. Emerging Threats and Solutions for Smart Transport and Connected Vehicles by Mr Vladimir Yordanov, Enterprise Cyber Security Officer, Huawei Technologies Co., Ltd.

As vehicles and transport systems become increasingly connected with the external world, they face a growing range of security vulnerabilities.

The security vulnerabilities and challenges facing today connected vehicles and modern transportation systems continue to evolve. Organizations must now consider issues such as device and user authentication, securing code updates against tampering, protecting the sensitive data captured and transmitted by connected components, security of surveillance video stream, security of command and control channels and many others.

When it comes to transportation security, organizations must consider multi-layered, multi-service security approach to safe guard and protect devices, infrastructure and data against modern cybersecurity threats.

How can we build trusted and safe transport solutions? What security solutions and technologies needs to be considered? Join Huawei CSO Vladimir Yordanov to learn more about how to address the latest cyber security challenges in transportation surveillance and connected vehicles.

5. **A Practical Study on Driverless Valet Parking** by Dr Benjamin Ma, Senior Lecturer, Specialist (Autonomous System), Nanyang Polytechnic

Autonomous vehicle is the key technology to transform urban mobility and logistics industry. In this talk, the speaker will discuss his recent work on driverless valet parking. In particular, simulation model, path planning method for driverless vehicle auto-parking and vehicle control are discussed in detail.

6. **Physical Sensor Attack on CAVs**

by Dr Tan U-Xuan, Assistant Professor, Engineering Product Development, Singapore University of Technology and Design

There has been an increasing demand for autonomous vehicles to provide various services and solutions. These autonomous vehicles are equipped with critical sensors to achieve the required intelligence to ensure safety and complete its tasks. Hence, ability to withstand or mitigate physical sensor attacks is required and gaining importance. Examples of physical sensors that can currently attacked includes GPS, IMU and ultrasonic sensors. In this presentation, an overview of current potential physical sensor attacks on autonomous vehicles is provided. In additional, an example on how the effect can be mitigated through sensor fusion algorithm is provided.

7. **Connected and Autonomous Vehicle Initiatives in Singapore** by Ms Joanne Cheong, Manager, Connected ITS, ITS Development Division, Land Transport Authority

Singapore is facing the pressure of aging population, increasing travel demand and changing aspirations in the lifestyle of our commuters. To tackle such trends, there's a need to stay ahead of the curve and seeking opportunities to harness the emerging disruptive technologies that can improve the lives of our commuters. In this presentation, the audience will be given an overview of the various Connect and autonomous vehicle initiatives in Singapore that aims to create a more liveable and sustainable land transport ecosystem for our commuters

8. **The Major Obstacle for Mass Commercialisation of Self-driving Cars**

By Dr Song Zhiwei, Founder and CEO of Singpilot Pte. Ltd

The Society of Automotive Engineers categorised autonomous driving in six levels. The highest level is Level 5 of Full Automation, which means that the system cope with all the situations automatically during the whole journey and no driver is required to the point of not having controls at all.

The question is what hardware will allow us to get to the level five? Companies like Google are replying on Lidar technology. A 3D point-cloud map built by laser data and SLAM algorithms provide an accurate location result by matching the real-time laser data to the map.

The current price of the 3D Lidar is high and the 3D map is huge, which make it a major obstacle from being applied across the industry on a scale. Then how to resolve this obstacle and who is going to do that? Let's find out more during the talk.

9. Development of an autonomous, road bound, electric public transport mode to supplement the Singapore public transport system

By Dr Andreas Rau, Principal Investigator, TUM CREATE, Rapid Road Transport Group

Singapore, like many other fast growing cities with strong economic growth is constructing the Mass Rapid Transit (MRT) network on top of the existing bus network leading to a two layered public transport system. In European cities, there exists an additional intermediate layer of the Light Rail Transit (LRT) or the Bus Rapid Transit (BRT). The presentation shall discuss the feasibility and potential of such an additional public transport layer while also focusing on its integration with the existing transport system in cities like Singapore, and assuming that new/emerging technologies including autonomous driving, electrification, C2X technology etc. are ready for implementation.

Profile of the Speakers

Dr Marcelo H Ang Jr
Ag Director, Advanced Robotics Centre
National University of Singapore

Marcelo H Ang Jr received his BSc and MSc degrees in Mechanical Engineering from the De La Salle University in the Philippines and University of Hawaii, USA in 1981 and 1985, respectively, and his PhD in Electrical Engineering from the University of Rochester, New York in 1988 where he was an Assistant Professor of Electrical Engineering. In 1989, he joined the Department of Mechanical Engineering of the National University of Singapore where he is currently an Associate Professor and Acting Director of the Advanced Robotics Center. His research interests span the areas of robotics, mechatronics, autonomous systems, and applications of intelligent systems. He teaches robotics; creativity and innovation; applied electronics and instrumentation; computing; design and related areas. In addition to academic and research activities. He is also actively involved in the Singapore Robotic Games as its founding chairman, and the World Robot Olympiad as member of its Advisory Council.

Dr Benjamin Ma
Senior Lecturer, Specialist (Autonomous System)
Nanyang Polytechnic

Dr. Benjamin Ma obtained his B.Eng (control) with first class honours and Ph.D from School of EEE, Nanyang Technological University. He has more than 10 years of experience in both industry and research institution. He has been the lead developer and system architect for a number of military products and research prototypes including personalized surveillance robot, medical implant, wireless sensors and etc. In NYP, he mainly focuses on autonomous systems such as driverless vehicles, service robot, autonomous drones, etc. Dr. Ma is also specialized in embedded system development and is well-versed in various microprocessors such as ARM, PIC, TI MSP and etc.

Dr Yang Ming
Project Manager, Centre for Infocomm Technology (INFINITUS)
Nanyang Technological University

Dr. Yang Ming obtained his PhD degree from Nanyang Technological University. Currently, he is the project manager and system architect of NTU-NXP Smart Mobility Test Bed project. Before he joined NTU, he was working as the system architect with Harmonic Inc., a global leader of end-to-end video delivery solution company. His current research interest focus on the IPv6 based seamless roaming solution for 802.11p mobile clients. He has submitted a pending patent on this topic.

Dr Roland Bouffanais
Assistant Professor, Engineering Product Development,
Singapore University of Technology and Design

Dr. Roland Bouffanais is an Assistant Professor at the Singapore University of Technology and Design (SUTD). He received his Ph.D. from EPFL (Lausanne, Switzerland) in computational science for which he received the prestigious IBM Research Prize in Computational Sciences (2008) and the ERCOFTAC Da Vinci Award Silver Medal (2007). He has been a postdoctoral fellow and associate at MIT and still is a research associate with the Department of Mechanical Engineering at MIT. Bouffanais' research group—the Applied Complexity Group—focuses on fundamental and applied interdisciplinary problems rooted in the field of complexity science. Bouffanais leads a number of active projects at SUTD related to complex networks and self-organizing systems, including swarming systems. He has recently authored a monograph titled “Design and Control of Swarm

Dynamics”, published by Springer in their Complexity Series in 2016.

Mr Vladimir Yordanov
Enterprise Cyber Officer,
Huawei Technologies Co., Ltd.

Vladimir is a senior cyber security expert for Huawei Enterprise Business Group, based out of the corporate HQ in Shenzhen. In this capacity he is responsible for working on the cybersecurity solutions strategy, and is an advisor to customers and business while maintaining close relationships with the technical community. He also serves as evangelist and speaker, communicating to customers, partners, and industries at large Huawei’s overall vision and strategy for innovative and secure ICT.

Vladimir has close to 20 years of experiences in the cybersecurity field. Prior to joining Huawei, he has held senior technology leadership and management positions with companies like Imperva, Samsung, F5 Networks and PricewaterhouseCoopers.

Throughout his career, he has covered in depth all major aspects on the cybersecurity such as Networks, Parameter, Data and Information, Applications, Cloud and for the last several years – Internet of Things. With a combination of in-depth technical knowledge of cyber defenses and attacks, and expert in balancing business objectives & technology solutions, Vladimir is trusted and influential advisor to senior executives and line managers alike. His solutions has helped a number of multinational organizations and governments to build a resilient cybersecurity defense infrastructures that withstand and adapt to the latest attack and threats.

Vladimir is one of the pioneers of cybersecurity and has spent the last several years analyzing the development of the new ICT technologies, emerging threats, investigations and compromised recoveries. He has worked on number of assignments, helping organizations in their prior or post attack investigations, analysis, recovery and remediation, and overall cyber-defense strategy covering all layers and services of the enterprise ICT infrastructure.

Dr Tan U-Xuan
Assistant Professor, Engineering Product Development
Singapore University of Technology and Design

Dr Tan U-Xuan has been with Singapore University of Technology and Design since 2012 where he is designing an algorithm for design of compliant mechanism. He is also actively involved in designing pedagogy and activities that enable students to learn better. Prior to that, he conducted his post-doctorate research with Professor Jaydev Desai at University of Maryland, College Park, where he designed an MRI-compatible robotic system for breast biopsy. In addition, he managed to develop both a tri-axial MRI compatible fiber-optic force sensor and a miniature capacitive force sensor for catheters.

He earned his Ph.D. in Mechanical & Aerospace Engineering from Nanyang Technological University under the advice of Assoc. Professor Wei Tech Ang and his Ph.D. was on design and control of piezoelectric-driven handheld manipulator for tremor compensation in microsurgery. Along the way, he also managed to perform clinical trials and commercialize a balancer trainer that he designed.

Ms Joanne Cheong
Manager,
Connected ITS, ITS Development Division
Land Transport Authority

Ms Joanne Cheong is the Manager of Connected-ITS for Intelligent Transport Systems Development (ITSDV) Division, Land Transport Authority. She is currently leading her team in the area of Traffic Data Collection and

Information Dissemination under the Next-Generation Road Pricing System; V2X projects and trials (e.g. giving priority to bus and emergency vehicles); as well as the assessment and implementation of infrastructure to support Autonomous Vehicle trials and future operations.

Dr Song Zhiwei
Founder and CEO
SingPilot Pte. Ltd.

Dr. Song Zhiwei specializes in technologies for robotics and autonomous vehicle. He received his B.E degree from Special Class for Gifted Youth (SCGY), University of Science and Technology of China in 2001, and Ph.D in computer science from Department of Computer Science and Technology, University of Science and Technology of China in 2006. He started his robotics R&D since he won the champion in the First RoboCup Competition of China in 1999, when he was an undergraduate student. Since then, he developed many robots and won many awards, such as an 1.4 meter tall two-legged humanoid robot which won the 2nd place of Humanoid Adult-Size Robot in RoboCup 2010. He was the key developer of the Singapore first autonomous vehicle prototype in A*STAR, which Prime Minister Lee rode in October 2015. Recently, he founded a startup company, SingPilot, working on autonomous vehicle technology development for industrial logistics and services as well as public transportation.

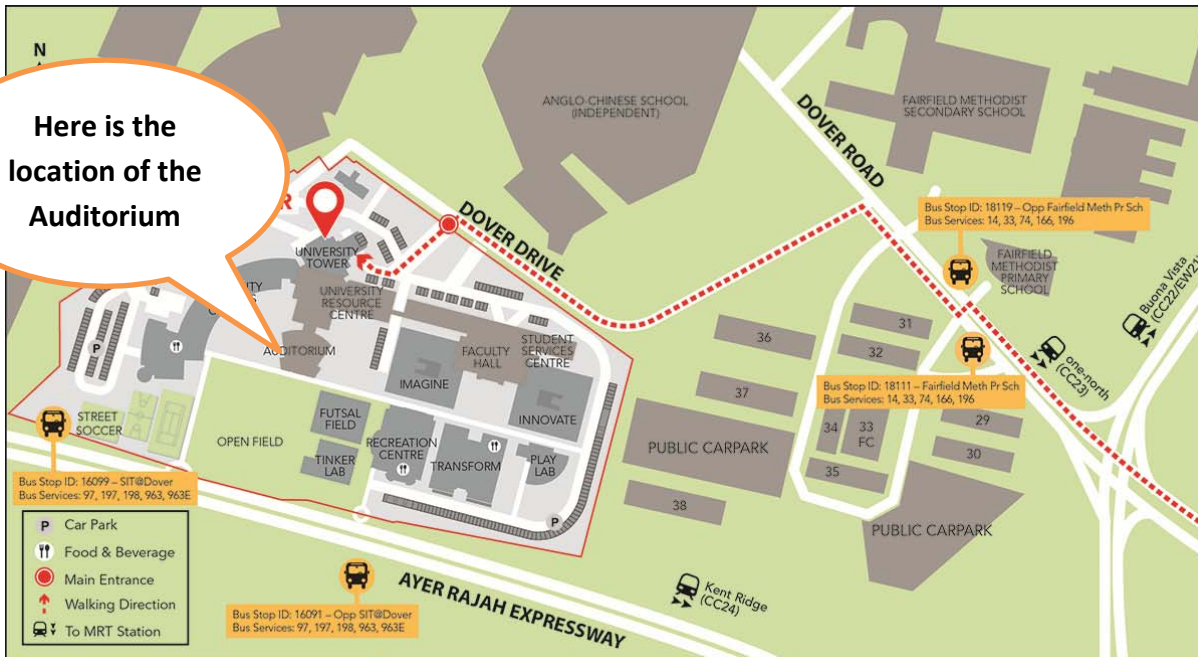
Dr Andreas Rau
Principal Investigator
TUM CREATE Rapid Road Transport Group

Dr. Rau joined TUM CREATE Limited in Singapore since 2011 as a Principal Investigator. His significant research experience contributed in public transport planning, development and implementation workshops and research projects funded by public transport authorities, and education institutes in Germany and Singapore. With a strong academic and teaching background, Dr. Rau was the Founding Director of MSc programmes at TU München and the German Institute of Science and Technology – TUM Asia, Singapore. He is teaching public transport planning courses for Technical University of Munich (TU Munich), Singapore University of Social Sciences (SUSS), and at Tsinghua University, Beijing. He is a frequent speaker in seminars, conference and training from all around the world.

Programme

0830 – 0900 hrs	Registration
0900 – 0910 hrs	Welcome speech by Mr Lew Yii Der, Chairman, Railway & Transportation Technical Committee, Group Director, Corporate Planning & Development Group, Land Transport Authority
0910- 0940 hrs	Full Mobility using Autonomous Vehicles towards Better Living By Dr. Marcelo H. ANG Jr, Ag Director, Advanced Robotics Centre, National University of Singapore
0940 – 1010 hrs	Development of road bound, autonomous, electric public transport mode to supplement the public transport system of Singapore By Dr. Andreas Rau, Principal Investigator, TUM CREATE Rapid Road Transport Group
1010- 1030 hrs	Q&A, Presentation of Token of Appreciation
1030 – 1100 hrs	Coffee Break
1100 – 1130 hrs	Cellular V2X – another supporting technology for Connected Vehicles By Dr Yang Ming, Project Manager, Centre for Infocomm Technology (INFINITUS), Nanyang Technological University
1130 – 1200 hrs	Swarm Robotics by Dr Roland Bouffanais, Assistant Professor, Engineering Product Development, Singapore University of Technology and Design
1200 – 1230 hrs	Emerging Threats and Solutions for Smart Transport and Connected Vehicles by Mr Vladimir Yordanov, CSO, CTO, Cyber Security Expert, Technology Evangelist and Consulting Executive, Huawei Technologies
1230 – 1300 hrs	Q&A, Presentation of Token of Appreciation
1300 – 1400 hrs	Lunch Break
1400 – 1430 hrs	Connected and Autonomous Vehicle Initiatives in Singapore By Ms Joanne Cheong, Manager, Connected ITS, ITS Development Division, Land Transport Authority
1430 – 1500 hrs	Physical Sensor Attack on Cavs by Dr Tan U-Xuan, Assistant Professor, Engineering Product Development, Singapore University of Technology and Design
1500 – 1530 hrs	A Practical Study on Driverless Valet Parking by Dr Benjamin Ma, Senior Lecturer, Specialist (Autonomous System), Nanyang Polytechnic
1530 – 1600 hrs	Tea Break
1600 – 1630 hrs	The Major Obstacle for Mass Commercialisation of Self-driving Car by Dr Song Zhiwei, Founder and CEO, SingPilot Pte. Ltd.
1630 – 1700 hrs	By Dr Guan Yong Liang
1700 – 1730 hrs	Q & A. Presentation of Token of Appreciation

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Address : 10 Dover Drive, Singapore 138683

Nearest : Buona Vista (CC22/EW21), one-north (CC23),
MRT Station Kent Ridge (CC24)

Bus Services : 14, 33, 74, 97, 166, 196, 197, 198, 963, 963E

From Buona Vista (CC22/EW21)

1. Take Exit 'D' via the underpass leading to MOE Building.
2. (From Bus Stop ID: 11369, Opposite Buona Vista Station) via Bus Services 196 or 74 Alight at Bus Stop ID: 18119, opposite Fairfield Methodist Primary School. Walk towards Dover Drive and follow the walk-way leading to SIT@Dover.
3. (From Bus Stop ID: 11369, Opposite Buona Vista Station) via Bus Service 198 Alight at Bus Stop ID: 16091, opposite SIT@Dover. Cross the overhead bridge leading to the back gate.*

From one-north (CC23) Walking distance: approx 0.8 km

1. Take Exit 'A' and walk towards the direction of Dover Road. You will see INSEAD on your right.
2. Cross the first traffic junction and walk towards Fairfield Methodist Primary School.
3. At Fairfield Methodist Primary School, you will see Dover Drive across the road.
4. Walk towards Dover Drive and follow the walk-way leading to SIT@Dover.

From Kent Ridge (CC24)

1. Take Exit 'A' and walk towards the direction of Lower Kent Ridge Road.
2. (From Bus Stop ID: 18071, NUH Bus Stop) via Bus Services 97, 197, 963/963E Alight immediately at the next stop, Bus Stop ID: 16091, opposite SIT@Dover.
3. Cross the overhead bridge leading to the back gate.*

*Gate Opening Hours: Monday to Sunday – 7:00am to 12:30am
Gate will be closed on Public Holidays.



TERMS & CONDITIONS

Registration

- Online registration at
- Registration will be on a first-come-first-served basis as seats/places are limited and will only be accepted upon the receipt of full payment or otherwise indicated.
- Please notify us in writing of any change in your registration 7-working days before the commencement date.
- We only accept online registration with full payment or otherwise indicated.

Registration Closing Date/ Time & Payment

- Registration closing date/ time: before 1700 hours, 1 Feb 2018 (Thursday)
- Cheque or Cashier's Order should be **crossed A/C payee only, Payee: IES** and post to:
The Institution of Engineers, Singapore
70 Bukit Tinggi Road
Singapore 289758
Attention: Mr Yue Kok Sun
(At the back of your Cheque, please indicate your Name and **TS18**)

Confirmation of Registration

- Confirmation of registration will be forwarded to your registered/ recorded email address within 7-working days prior to the commencement date.

Withdrawals/ Refunds of Fees

- Notice of withdrawal must be given in writing to IES, policy on refund of fee is as follows:
- Within 7-working days before the commencement date: No refund.
- Full payment is still applicable if you are not able to turn up due to work for the Seminar.
- Replacement is allowed but restricted to once only with written notice, it must be received by IES 7-working days before the commencement of the Seminar. However, when an IES member is replaced by a non-member, the participant has to pay the difference in the relevant fees.
- FULL refund if IES receives your written notice of withdrawal at 14-working days before the commencement of the Seminar.
- For e-payment, a 4.5% (online transactional service charges) will be borne by the Registrant.
- No refund otherwise.
- No show of participant would not be accepted as reason for withdrawal/refund.

Cancellation/ Postponement

- Changes in Venue, Dates, Time and Speakers for the Seminar can occur due to unforeseen circumstances. IES and/ or the Organiser(s) reserves the full rights to cancel or postpone the Seminar under such circumstances without prior reasons. Every effort, however, will be made to inform the participants or contact persons of any cancellation or postponement.
- Fees will be refunded in FULL if any Event is cancelled by IES and/ or the Organiser(s).
- Alternate Payment via AXS Kiosks
- Please download <https://www.ies.org.sg/axs/AXSprocedure.pdf> for more information.
- Please select/ input/ key in: -
Course/ Event ID
Remarks **TS18**
- Please keep, retain and furnish your proof of payment(s), receipt(s) or e-receipt(s), if any, during registration.

Contact Person

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Fees are inclusive of GST with tea break and lunch.

Should you require any "Vegetarian Bento Set', please indicate under the remarks column

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For Student Members @ Free of Charge (Limited to 20 seats Only) ***Please include your name, email address, contact number and student pass number in the Remarks column.***

Certificate of Attendance will NOT be issued, however, an email proofing your attendance will be forwarded to your recorded/ registered email address normally within 14 to 21 working days after the Seminar.

Accreditation of CPD PDU for Professional Engineers Board Singapore (PEB) Professional Engineer/ Attendee; your Name and Reg. PE Registration Number will be electronically filed with or manually submitted to PEB, normally within 14 to 21-working days after the Seminar.

Accreditation of CPD PDU for IES Chartered Engineer/ Attendee; your Name and Reg. C.Eng Registration Number will be electronically filed with or manually submitted to IES C.Eng Professional Registry, normally within 14 to 21-working days after the Seminar. ***CPD PDU for IES C.Eng will be duly accredited/ awarded correspondingly/ similarly to those approved/ confirmed by PEB.***