KEYNOTE SPEECH I

Wednesday, Sep 15, 14:20-15:20

Chair: Pei-Jun Lee (National Taiwan University of Science and Technology, Taiwan)

Autonomous Driving: Status, Challenges, and Opportunities

Jyh-Ching Juang

Professor, Department of Electrical Engineering,
National Cheng Kung University, Taiwan

Abstract

The mobility of humans and goods is currently undergoing a paradigm shift towards autonomous, connected, electrified, and shared (ACES) driving. An ACES vehicle is equipped with all-around sensors such as cameras, radars, lidars, and thermal imagers to make intelligent decisions. Through sensing and fusion, relevant objects in the driving environment are perceived, detected, and tracked. Similarly, the ego-vehicle is localized with an acceptable accuracy and integrity. The long-term route and short-term path are then planned accordingly for the vehicle to move to the destination efficiently. The motion of the vehicle is then controlled based on the plan. The perception capability of sensor-based solutions is, however, limited in spite of the sensor fusion techniques that are used. Also, the processing complexity must be matched with appropriate processing power to achieve a balance in cost and performance. To increase the level of autonomy, a beyond-sensor-range solution is thus needed. A two-way connectivity between vehicles and control center is envisioned in which vehicle-relevant information is uplinked to the control center for better monitoring and coordination, and dynamic traffic and map information is downlinked to the vehicles for safe and efficient operation. To achieve a responsive and trustworthy implementation, edge computation plays an essential role. The investigated edge computation is characterized by the software framework and, more importantly, an assessment of the real-time computational loads in autonomous driving. The connectivity performance is being enriched by 5G and the edge computing is infused with light-weight deep learning schemes. Overall, this implies that future intelligent vehicles will employ the SPACE (sense, plan, act, connect, edge computing) technologies. In the presentation, the development, integration, and test of SPACE technologies at the National Cheng Kung University's autonomous driving vehicle are delineated. Before a full deployment of smart vehicles, many challenges remained to be tackled. For example, the traffic environment in Taiwan is signified by mixed traffic pattern that is made of pedestrians, motorcycles, and various kinds of vehicles. The environment thus poses challenges in the perception and decision making for self-driving vehicles and a solution that is adapted to the traffic condition can potential be applicable in other Asian countries. In the presentation, some challenges and opportunities are discussed with the goal of paving the way for safe, efficient, and environmental-friendly mobility.

KEYNOTE SPEECH I

Biography

Jyh-Ching Juang is a Professor at the Department of Electrical Engineering, National Cheng Kung University, Taiwan. He received the B. S. and M. S. degrees from National Chiao-Tung University, Hsin-Chu, Taiwan, in 1980 and 1982, respectively, and the Ph. D. degree in electrical engineering from University of Southern California, Los Angeles, in 1987. He was with Lockheed Aeronautical System Company, Burbank before he joined the faculty of the Department of Electrical Engineering, National Cheng Kung University, Tainan, Taiwan in 1993. Dr. Juang is one of the premier researchers in GNSS (Global Navigation Satellite System) in Taiwan. He has developed several advanced algorithms for GNSS receivers and applications. Under the support of the National Cheng Kung University, Dr. Juang has been coordinating a team that is devoted to the research on autonomous driving techniques. Highlights of the autonomous driving research includes the inclusion of deep learning and sensor fusion for perception, vehicle localization with adaptive environmental features, open-source software development for multi-core platforms, and exploration of HD maps in autonomous driving for enhanced performance and safety.

KEYNOTE SPEECH II

Wednesday, Sep 15, 17:10-18:10

Chair: Wen-Chung Kao (National Taiwan Normal University, Taiwan)

Activities for Development of Educational Materials Using 3D Graphics and VR/AR

Yoshihiro Okada

Professor, Innovation Center for Educational Resources,
University Library of Kyushu University, Japan

Abstract

In this talk, Prof. Okada introduces his research activities about 3D graphics applications. He has been studying development environments for 3D graphics applications since 1993. In 1995, he and his laboratory professor proposed a development system for 3D graphics applications called IntelligentBox. In the first half of this talk, he introduces IntelligentBox and its several example applications including educational applications, e.g., a collaborative dental training system, Tai Chi-based physical therapy game and so on. Currently, Prof. Okada works as a director of ICER (Innovation Center for Educational Resources) of Kyushu University. In the second half of this talk, he introduces development activities of ICER for e-learning materials using 3D graphics and VR/AR, e.g., web-based interactive educational materials for Japanese history, IoT security and medical education.

Biography

Yoshihiro Okada is a Professor of ICER (Innovation Center for Educational Resources), University Library of Kyushu University, Japan. He received his doctorate of Engineering from Hokkaido University, Japan in 1993. After that, he worked as a Research Associate at Department of Electrical Engineering, Faculty of Engineering, Hokkaido University. He was an Associate Professor of Computer Center, Kyushu University, Japan since 1999 and an Associate Professor of Graduate School of Information Science and Electrical Engineering, Kyushu University since April, 2000. He obtained his current position in 2013. He has been a director of ICER since April, 2015 and a vice-director of Cybersecurity center of Kyushu University since 2017. Currently, his research interests include 3D Graphics, HCI, VR/AR, network collaboration, educational material development and cybersecurity.

KEYNOTE SPEECH III

Thursday, Sep 16, 10:50-11:50

Chair: Ding-Bing Lin (National Taiwan University of Science and Technology, Taiwan)

RF Hardware Design for 5G mm-Wave and 6G Revolutions: Challenges and Opportunities

Donald Y.C. Lie

- Keh-Shew Lu Regents Chair Professor, Department of Electrical and Computer Engineering, Texas Tech University, USA
- Adjunct Professor, Department of Surgery, Texas Tech University Health Sciences Center, USA
- Chair Professor, College of Electrical Engineering, National Yang Ming Chiao Tung University, Taiwan
- IEEE Fellow

Abstract

The fifth-generation (5G) mobile network technologies promise to deliver 10-Gbps peak data rate for 5G eMBB (enhanced Mobile Broadband) applications, sub-1ms latency and ultra-reliability for 5G mMTC (ultra-reliable machine type communication), and massive network capacity with increased availability to enable IoE (Internet-of-Everything) with x100 more wireless connected devices compared to 4G for 5G mMTC (massive machine type communication). To accomplish these challenging goals, it is imperative to move up from the sub-6 GHz 5G FR1 band to the millimeter-wave (mm-Wave) 5G FR2 band (i.e., 24.25 to 52.6 GHz). For example, 5G eMBB applications must use the 5G FR2 band to support numerous users with very high data rates in high-density urban areas, while also reducing the total cost and improving energy efficiency. However, the hardware requirements for mm-Wave 5G are putting serious pressures on the 5G hardware design communities.

Since the 5G FR2 band is ~ 4 to 75 times higher in frequency compared to the FR1 band, the power-added efficiency (PAE) of a 5G mm-Wave power amplifier (PA) will be considerably lower, making the mm-Wave PA a critical component and a very challenging barrier to low-power mm-Wave 5G. The mm-Wave 5G also presents some practical problems on the design of handsets and wireless infrastructures with multiple-input multiple-output (MIMO) antennas, as well as broadband modulated signal bandwidth, which demand wideband electronics, stringent linearity and effective beamsteering. Mm-Wave 5G MIMO systems also have considerably more PAs, RF switches, phase-shifter, low-noise-amplifiers (LNAs) and/or filters integrated in the RF front-end modules (FEMs) to achieve beamsteering to compensate for the path loss and blocking effects, making the performance and cost of these FEM hardware critical for the success of 5G mm-Wave consumer applications. The performance and cost of the RF hardware become even more essential and challenging as the industry evolves into the AI-centric 6G technologies that utilize Tera Hertz (THz) communications to achieve 1-Tbps peak data rate (i.e., x100 faster than 5G), with x10 reduced latency and x10 more connected devices than 5G.

In this talk, I will start with an introduction of the key 5G and 6G technology delivery goals, followed by a more detailed discussions on the hardware capabilities required for 5G mm-Wave applications. These may cover the hardware requirements on ultra-broadband mm-Wave fixed “last-mile” links, mobile handsets, mesh-enabled radios, base stations and small cells that can all contribute to reaching commercial 5G viability and open ultra-high-bandwidth low-latency applications in mobile virtual reality, robotics, automated manufacturing, etc. I would attempt to translate the requirements for some of these driver applications into hardware needs for mm-Wave 5G and also briefly for 6G, such as on the desired improvements in power efficiency, linearity, semiconductor technologies, and integration techniques.

KEYNOTE SPEECH III

Biography

Donald Y. C. Lie received his B.S.E.E. degree from the National Taiwan University in 1987, and the M.S. and Ph.D. in electrical engineering (minor in applied physics) from Caltech, Pasadena, in 1990 and 1995, respectively. He held technical and managerial positions at companies such as Rockwell International, Silicon-Wave (now Qualcomm), IBM, Microtune, and is currently the Keh-Shew Lu Regents Chair Professor in the Department of Electrical and Computer Engineering, Texas Tech University (TTU), an Adjunct Professor in the Department of Surgery, Texas Tech University Health Sciences Center (TTUHSC). He is also appointed as a Chair Professor, College of Electrical Engineering, National Chiao-Tung University (NCTU), Hsin-Chu, Taiwan, since 2018. He was a Visiting Lecturer to the ECE Department, University of California, San Diego (UCSD) during 2002-2007 and co-supervised Ph.D. students. He and his students have won 17 Best Paper Awards and authored over 230 peer-reviewed technical papers and book chapters with three TOP 100 most downloaded papers in IEEE Xplore™ and he holds seven U.S. patents. Dr. Lie is currently serving on the Executive or Steering Committees of the IEEE RFIC Symp., SiRF, MWSCAS, and TSWMCS (Texas Wireless Symp.), and on the Advisory Committee for IEEE VLSI-DAT. Dr. Lie has been awarded with 7 DARPA contracts at TTU, and has been serving on the IEEE 5G Technology Roadmap Hardware Technical Working Group (TWG). He is a Fellow of IEEE, a Senior Chapter Member of the National Academy of Inventors (NAI), and a member of ASCO (American Society of Clinical Oncology). His research interests are: (1) power-efficient 5G/6G mm-Wave/RF/Analog IC and system design; and (2) interdisciplinary/clinical research on medical electronics, biosensors and oncology.

KEYNOTE SPEECH IV

Friday, Sep 17, 10:50-11:50

Chair: Ming-Tien Wu (National Penghu University of Science and Technology, Taiwan)

Influencing Factor Considerations for Designing a High-Performance Compact Antenna Test Range (CATR)

Liu Rong-Zong

- President, WavePro Technology Corporation, Taiwan
- President, EMTREK Technologies Corporation, Taiwan
- President, Financial Research and Development, Foundation of Pacific Basin, Taiwan
- Executive Director, Taiwan Microwave Association, Taiwan

Abstract

Compact antenna test range (CATR) is popularly used to produce a plane-wave like field-distribution in a small designated quiet zone to resemble the actual far-field scenario in electromagnetic (EM) related measurement. The quiet zone's performance relies on many factors that should be compromised for a trade-off between performance and system complexity. This paper presents major design concerns from the realizable industrial aspects and discusses their solutions when designing a high-performance CATR.

Biography

Rong-Chung Liu (Richard Liu) established WavePro in 1993 as the first EM test company in Taiwan.

Prior to WavePro, he graduated from National Taiwan University EE-EM group master program in 1988 (PhD candidate in YZU now). He volunteered military service in NCSIST as the manager of Compact Range Test Lab to develop EM test system for military applications, including RCS, radar test and various antenna pattern tests for 6 years.

Based on massive experiences of EM test system installations and tests, WavePro has developed superior performance Compact Antenna Test Ranges (CATR) for ultra-accurate military applications since 2009. Also, he developed ultra-broad band CATR which has been accepted by many famous base station antenna players for 5G FR1/FR2 applications. In addition, the CATR from WavePro has been certified by Qualcomm for 5G tests.

He also has devoted to serve EM society in Taiwan wholeheartedly. He was the Vice-chair and the Chairman of Taiwan Microwave Association (TMA) during 2013-2015 and 2015-2019, respectively.