ADAS & Active Safety Systems

Session Code: ICAV100

Room TBD  Session Time:

Topics include active safety systems, ADAS, and related human factors such as driver behavior, fatigue detection and health monitoring.

Organizers - Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

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<td>ORAL ONLY</td>
<td>How AI and deep learning enables next generation driver and cabin monitoring</td>
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<td>As autonomous vehicles make progress, it is important for cameras to better &quot;understand&quot; the driver, occupants, and the entire cabin. With the progress of deep learning, it is now possible to provide extremely accurate driver and cabin monitoring, in real time, using inexpensive camera sensors and available compute resources in the vehicle, leading to cost effective deployment options. We will show CoDriver, our end to end driver and cabin sensing software, and some of the innovations made available using AI/Deep learning. We will also demonstrate how these technologies transform the way car OEMs think about cabin sensing.</td>
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Automated Driving & AI

Session Code: ICAV200

Room TBD  Session Time:

Topics include artificial intelligence applications, automated driving, and testing and simulation of automated vehicles.

Organizers - Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

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Future Sensors for Autonomous Driving: Robust Detection of Any Obstacle Under Any Weather and Lighting Conditions

One of the biggest challenges standing in the way of autonomous vehicles is the ability to drive under any weather and lighting conditions. Poor weather conditions account for 22 percent of automotive accidents in the United States. Weather conditions such as fog, rain, snow can lead to fatal accidents if the driver is not able to detect obstacles and respond appropriately. Autonomous vehicles are designed to provide the highest safety driving levels and must cope with any weather condition to drive safely.

It is a common understanding that autonomous driving will require data fusion from multiple sensors for redundancy purposes and for increased sensing robustness. For example, dense fog or heavy snowfall create significant challenges for visible light cameras and for LiDARS. Radar, on the other hand, can cope better with this condition, but lacks the required resolution to allow safe autonomous driving.

Foresight has developed a unique multispectral vision sensor. It is based on seamless fusion of 4 cameras – 2 sets of stereoscopic long-wave infrared (LWIR) and visible-light cameras, enabling highly accurate and reliable obstacle detection. Simultaneous information from both visible and thermal (far-infrared) stereo cameras significantly increases the ability to detect pedestrians, vehicles and other stationary or moving objects under severe weather and lighting conditions.

The goal of this presentation is to assess detection capabilities of different sensors in severe weather. Specifically, the visibility in a point cloud is compared for different types of obstacles (vehicles, pedestrians, other static and moving objects) using data recorded during day and night, using simulated fog and heavy rain. Detection capabilities for Foresight’s multispectral vision sensor are assessed using (a) stereo visible-light images; (b) stereo far-infrared images; and (c) a combination of visible and far-infrared stereo images.

The inevitable migration from AI to Edge-AI in automotive mobility services

All major automotive players are claiming they are migrating from being “just” car manufacturers, into becoming mobility service providers. But clearly, to address our multi-dimensional mobility needs, automotive players must have a much wider understanding of us as people and not only as drivers. The presentation will discuss:

- The missing piece of the puzzle to understand consumers 24/7 and to figure out their mobility needs on their mobile phone, and not only while they are at their car. No real “Mobility Service” is possible without being present on the user’s mobile phone.
- The only acceptable level of good mobility service is if it is personal and contextual. Personal service is equal to better engagement.
- Understanding the individual user.
- Understanding real-time context.
- Behavioral analysis for predictive services.
- The mobile phone will need to incorporate AI capabilities on-handset, and not only on the cloud.
- Ultra-low battery consumption is a must. Minimizing communication with the cloud is of paramount importance.
- Maintaining user privacy is mandatory. The user profile must be built on the handset and not on the cloud.
- The presentation will include live demonstrations of Edge-AI capabilities and examples.

Oren Bar-On, Foresight Automotive
Ofer Tziperman, Anagog, Ltd.
The usage of deep learning is growing, in particular for the automotive industry. To address the computation needs, many companies started to provide specific acceleration for deep learning. However, it is challenging to develop a single best deep-learning accelerator because of the rapid changes in the deep learning algorithms. Therefore some companies are using flexible logic like FPGA to address this challenge. In this talk we will discuss the deep-learning landscape in the automotive industry, and in particular we will focus on how to provide ASIC accelerator performance with FPGA flexibility. To achieve that, we will present the benefits of the Coarse Grain Reconfigurable Array (CGRA) technology, how it can be applied for deep-learning algorithms and compare it to fixed acceleration like Nvidia on one hand and FPGA on the other hand.

In order to be able to use the CGRA there are two main challenges that need to be addressed, (I) how to map deep-learning algorithms efficiently to it, and (II) can we make the thousand of async computing resources automotive safe? We will discuss both of those challenges and will focus how we can achieve ASIL-D CGRA, the first deep-learning accelerator that can be used for fully autonomous cars.

We will wrap up the talk with couple of examples of how this solutions can be used in actual automotive systems, both in the sensor and control system.

Itai Yarom, Wave Computing

Advanced Sensor Fusion

In order for the autonomous vehicle to "feel" its environment, many sensors of different types are needed: a number of peripheral cameras, LiDARs for all light conditions, and radar that are currently being revived, with a significant improvement in their ability to observe details even in dark and difficult weather conditions. The challenge of using the data flows from all relevant sensors, and creating a unified perception that will be meaningful, is called "sensor fusion".

A good sensor fusion solution requires the transmission of all sensor data to the same time and space scale; However not all sensors use the same scale. In fact, almost no sensor is similar to the other, and the task of doing sensor fusion using the existing AI engines is a task that requires placing a super-computer in the vehicle.

Therefore most solutions present a compromise: processing of each sensor or group of similar sensors is performed separately. For each group, identify the important objects it occupies, and then inject the results into a high-level processing. In any case, even at the most basic level, it must be ensured that the object identified by radar or LiDAR is the same as the object detected by the camera, etc. This is not a simple challenge, and requires adjustment and calibrations of the sensors, handling reflections from different objects, etc. Other objects in the sky are relatively clean: the vehicle sensors operate in a "noisy" environment. Another problem with sensor fusion is when an object is partially hidden, or only part of it is detected by the sensor.

In our paper and presentation we will describe sensor fusion challenges and various advanced solutions for sensor fusion.

Ehud Spiegel, IonTerra
Distributed Acoustic Sensing for Smart Transportation: Using Deep Learning Approaches for Processing Fiber-optic Sensors Data

Most visions of future smart transportation and smart cities include deployment of large scale traffic monitoring sensor networks. Such sensor networks are required to be: Compatible with transportation infrastructure, durable and robust in outdoor conditions, simple and fast to deploy, cost-effective, reliable and allow continuous operation, immune to electromagnetic and weather-related interference and having minimum latency. Fiber-optic Distributed Acoustic Sensing (DAS) is an emerging technology, which possesses all these attributes and stands out as the most viable candidate for the aforementioned task. In DAS, a conventional telecommunication type optical-fiber cable is transformed into an array of thousands of microphones/geophones. This cable can be deployed along tens of kilometers and monitor, with spatial resolution of few meters, traffic-relevant physical parameters such as strain, temperature and vibrations. However, the tasks of automatically detecting, localizing and classifying events of interest are very challenging. The main obstacles are the complexity of the recorded optical signals and the enormous amount of raw data produced, which can reach Tera-bytes per day. In this interdisciplinary research, we propose the use of state-of-the-art deep learning methodologies to extract important information from TAU developed fiber-optic DAS-acquired data and tackle the complicated classification task. Since the training phase necessitates a large amount of tagged data, we use Generative Adversarial Networks (GANs) to efficiently increase the training dataset with simulation signals. Using relatively small experimental dataset, which is labeled manually, GANs transform approximate simulation data to data which accurately mimic genuine data. The classification network is first trained on refined simulation data and then fine-tuned on a small experimental dataset. This method enables real-time detection and localization of events of interest, such as a walking person, a moving vehicle, and others, with high accuracy over tens of kilometers.

Lihi Shiloh, Avishay Eyal, Raja Giryes, Tel Aviv University

Touch down on AI and self driving cars

As a new Autonomous driving company (FABU), we put ourselves to front line of technology innovation. We develop automated driving full stack algorithms and AI processors on key elements of self driving cars which are Perception, fusion and decision/control. We will speak from our expertise on market acceptance, government regulations, and hardware advancement in recent years. We will speak about how multiple sensors varying from camera, radar and LiDARs can be integrated together to create smooth autonomous driving experiences. We will also pin point the struggles and benefits of applying machine learning to sensor data integrations and how important ML acceleration is to an AI processor.

Angela Suen, FABUai
**ORAL ONLY**  
**Bridging the Human and Machine Communication Gap: Adaptive and Intuitive Interfaces**

We frame the problem of understanding human machine interactions as one of bridging the gap in communication between an automated device and a human user. This gap results in non-natural or less-than-intuitive interactions and hence in a sub-optimal utilization of automation and a concomitant lack of understanding. The topic of HMI has primarily been studied by either focusing on the machine, or on the human side. Our claim is that we need to study the differences in communication between automated machines and human users to improve these interactions and maximize the benefits that can be attained by doing so. We present our computational approach to natural and intuitive interactions and conclude with applications to personal comfort in automotive case studies.

Claudia V. Goldman, General Motors Global R & D

**ORAL ONLY**  
**Legal Aspect - Connected and Automated Vehicle**

This presentation will cover legal aspects of the topic Connected and Automated Vehicle.

Gadi Ouzan, Shibolet law firm

**ORAL ONLY**  
**Deep Learning Processing Technologies for Embedded Systems**

Deep learning has become the most prominent technique for image processing in recent years. Alongside its superior accuracy in many tasks and its ability to adopt through training to various use cases, deep learning presents a significant challenge to available processors. The resources required for typical Neural Networks (NNs), when applied to real-life use cases such as high resolution, real-time sensory data, approach the high 10s terra multiply-and-add operations per second (TMACs), let alone the associated memory bandwidth needed for the task, and pose a significant challenge to existing processors™ technology.

Current state of the art solutions for running NNs are better suited for data center environment and are inclined to trade-off efficiency for the sake of higher peak performance. Similarly, latency can be compromised to gain better performance, in which case techniques such as batch processing can be employed. In an embedded environment, power consumption and cost are typically limited by a relatively rigid envelope. Processing must be carried out on the fly, image-by-image. This presents a new set of challenges, which require a new approach for designing processors to best fit the problem domain.

In this talk, we will present the problem of image processing in a typical AV/ADAS scenario, both in terms of required resources and of compute paradigm. We will start by exploring the theoretical limits for processing efficiency, compare this with reported results from various players in the industry, and analyze some of the deficiencies which contribute to the large gap between theory and practice for different approaches. A case study analysis will follow. We shall pick a case such as rear-view camera feed for parking assist as an example. This case will be thoroughly analyzed to exemplify some of the statements previously made. This exploration will float some of the inherent system issues, performance requirements and the huge potential unlocked by a capable solution for running NNs locally.

We shall conclude with guidelines for designing processing systems which are able to achieve the required efficiency for running state of the art deep learning on embedded devices.

Hadar Zeitlin, Hailo Technologies
ORAL ONLY  The Effects of Intersection Types on Drivers’TM Discomfort in Autonomous Vehicles

When asked about fully autonomous vehicles, people often express concerns regarding the vehicles’ safety. To address this problem and reduce the levels of concern, a better understanding of its underlying factors is needed. The current study’s goal is to model people’s psychological discomfort when riding fully autonomous vehicles, by identifying environmental factors and specific road patterns that induce it.

Ten participants were driven in a Wizard-of-Oz type experiment where the human driver was hidden from view. The idea was to simulate the experience of handing control over to a fully autonomous vehicle, and not having the ability to intervene.

By analyzing participants’ risk-related reactions and verbal utterances, we were able to identify six recurring factors that contribute to stress and anxiety. These factors, in order of importance, are: Vehicle’s speed, Crossing Traffic, Pedestrians, Road Geometry, Road Markings and On-coming Traffic. Also, all intersections along the experimental route were abstracted into seven distinct patterns: Straight Intersections, Roundabouts, Crosswalks, Left-Turn with On-Coming Traffic, Left-Turn without On-Coming Traffic, Right-Turn with Right-of-Way, Right-Turn without Right-of-Way. Additionally, we examined whether certain factors are more associated with specific road patterns.

We have several findings that will be discussed in the presentation. Of these findings, two stand out: 1) speed was the most concerning factor when the vehicle was approaching all types of intersections, and 2) roundabouts were the road pattern which raised the most concern.

In future research, we intend to utilize these findings to design interventions that could reduce passengers’TM discomfort. We expect these interventions to prove useful by accurately targeting the correct concern factor in different situations. Evidently, using accurate interventions to reduce discomfort may make the experience of riding a fully autonomous vehicle less stressful and more enjoyable.

Guy Cohen-Lazry, Ben-Gurion University of the Negev; Asaf Degani, General Motors LLC; Tal Oron-Gilad, Ben-Gurion University of the Negev

ORAL ONLY  Simulation Platform for the Autonomous age

According to Rand cooperation research, there will be a need for billions of test miles in order to make sure that the autonomous vehicles have achieved the quality level of a human which is not possible to be conducted in physical tests due to the high costs involved. The solution for that is virtual testing (simulation) but the challenge here is to make the simulation realistic enough so it can replace real driving and scalable.

Dan Atsmon, Cognata

Wednesday, January 16

Cyber Security
Session Code:  ICAV300
Room TBD  Session Time:
Session topics will include automotive cyber security and resiliency, data privacy and ownership, and related topics.
Organizers -  Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications
Deep Hacking the Automotive Cyberspace

Connected cars are the future, it just makes sense, doesn’t it? But as cars connect, there is the increased potential for security risks. 

Automation, AI, Machine learning and plain old style ECU’s contain an ever increasing computation load, an incredibly expanding code base, old and new sensors and algorithms. 

- How do hackers approach all of these?

A person skilled in reverse engineering and armed with certain tools may be able to eavesdrop on automotive control data. Even more, an advanced hacker could interfere, interact, and modify both the ECU itself and the data flowing across its wires.

The cybersecurity landscape is rapidly evolving and the ecosystems are continuously innovating to advance security for devices of all types. The automotive industry is being driven towards a quest for a higher level of security, due to the current plethora of applications, media files, and user inputs available in its systems.

This presentation will cover:

- An introduction to automotive computing environment from a hacker’s point of view.
- Why is secure hardware a must-have?
- Case study: Hacking a car, near or far.
  - Hacking hardware.
  - Hacking software.

Many solutions exist, many are offered, hack yourself to know which are good enough for you.

Securing the Connected Car from the Cloud

The automotive industry is accelerating toward a technology-centric future with connectivity at its heart. Disruption lurks at every turn. To stay relevant, carmakers are already beginning to change their traditional business models, embracing partnerships with tech providers and developing service oriented revenue streams. At the same time, aftermarket fleet operators are reaping the rewards of data-driven, connected vehicles to improve business operations and customer service and to drive competitive advantage. But to grow and succeed, the industry must also focus on the escalating cyber and fraud threats facing connected vehicles and fleets. The threat of data theft, service outage, fraud, misuse and even the physical safety of drivers and passengers should be paramount for all OEMs and fleet operators. Due to the complexity of the connected cars network ecosystem and the challenge of implementing in-vehicle cybersecurity solutions, especially to protect vehicles that are already on the road today or that will be shipped in the near future, connected cars need to be safeguarded by centralizing security in the automotive cloud, the demarcation point between the operational network (OT) and the information network (IT) to gain complete visibility of the entire connected car stack from multiple data sources, and achieve for end-to-end cyber detection. The presentation explores the current technology and connectivity transformations of the automotive industry, the security challenges facing OEMs and after-market connected cars, and how centralized approach to automotive cybersecurity helps stakeholders mitigate cyber and safety risk while boosting business success.

Yoav Levy, Upstream Security
Vehicle Safe-Mode Limp-Mode in the Service of Cyber Security

This presentation describes a concept for vehicle safe-mode, that may help reduce the potential damage of an identified cyber-attack. Unlike other defense mechanisms, that try to block the attack or simply notify of its existence, our mechanism responds to the detected breach, by limiting the vehicle’s functionality to relatively safe operations, and optionally activating additional security counter-measures. This is done by adopting the already existing mechanism of Limp-mode, that was originally designed to limit the potential damage of either a mechanical or an electrical malfunction and let the vehicle limp back home in relative safety. We further introduce two modes of safe-mode operation: In Transparent-mode, when a cyber-attack is detected the vehicle enters its pre-configured Limp-mode; In Extended-mode we suggest to use custom messages that offer additional flexibility to both the reaction and the recovery plans. While Extended-mode requires modifications to the participating ECUs, Transparent-mode may be applicable to existing vehicles since it does not require any changes in the vehicle’s systems; in other words, it may even be deployed as an external component connected through the OBD-II port. We suggest an architectural design for the given modes, and include guidelines for a safe-mode manager, its clients, possible reactions, and recovery plans.

We note that our system can rely upon any deployed anomaly-detection system to identify the potential attack.

This presentation shall describe the highlights of our recent efforts to implement and test a proof-of-concept system, in a real operating vehicle.

Tsvika Dagan, Tel Aviv University

A Thought-Provoking Discussion and Comparison of Security for Automotive On-Board Communication Technologies

Since its introduction in the 80’s, the CAN bus has found its way into the most critical vehicle communication domains. Having no built-in security, it has been one of the first and main points of concern of the automotive cyber security community over the last decade. The Ethernet network, on the other hand, although a bit older than the CAN bus, is still taking baby steps in automotive, and the disruptive dust has not yet settled. While IT network security is pretty much a done deal with innovation is now mainly happening at the end points, the situation with the Automotive sector is different. Amid architectural speculation, there are insights which network and security architects can apply these are the outcome of decades of experience from IT and industrial applications. With this mindset, the presentation will compare and contrast various features and aspects of CAN-bus and Ethernet vehicle communication technologies from security point-of-view. It will start with a background and technical overview. Next, will review the basic security offering of each technology, alongside the pains and gaps. Emphasis will be on the less commonly discussed comparison of the two technologies. Ethernet will be elaborated further, not only because the debate is still heated, but also because it demands more unique and elaborate considerations compared to CAN-bus, such as adoption of IT solutions, dynamic network management, delimitation between communication and security planes, etc. The presentation will conclude with a cool demonstration (either live or recorded, depending on availability) of a RC toy car setup which was enhanced by both CAN bus and Ethernet technologies, attack and defenses.

Moshe Karl, Arilou Technologies, Ltd.
ORAL ONLY

Real-World Adversarial Attacks on Traffic Signs

The security threat posed by the use of adversarial image as a tool of attack on the self-driving cars perception systems has been receiving a lot of attention during the last year. However, the works dedicated to the real-world attacks are scarce, the most of researchers are concentrating on the adversarial transformation of the image files. In this paper, we propose a simple method for producing adversarial images for the real world based on the detection of the areas the contribute the most to the image classification. We describe the method and the first results obtained by its application to the GTSRB traffic sign dataset.

Alexander Kreines, Harman International

2019-01-0098

Optimizing CAN Bus Security with In-Place Cryptography

Today’s vehicles rely on multiple interconnected networks of Electronic Control Units (ECUs) that govern almost every automotive function “ from engine timing and traction control to side-mirror adjustment and GPS. In-vehicle networks used for inter-ECU communication, most commonly the CAN bus, were not designed with cybersecurity in mind, and as a result, communication by corrupt devices connected to the bus is not authenticated.

A multitude of attack vectors allow attackers to control a device on the bus; reports abound of successful hacking of vehicles, by exploiting vulnerable devices and by spoofing messages.

Such remote-connectivity and physical-access exploit types must be prevented, to mitigate the threats of impersonation, eavesdropping, replay and reversing.

Because an adversary’s chances of successfully injecting a spoofed message are equal to the chances for a random message, a validation method is called for which is able to reject a random message deterministically.

We present the IVAS, In-Vehicle Authentication Scheme. IVAS is an in-place cryptographic scheme: the first CAN messaging solution to ensure both authentication and confidentiality without additional data such as authentication tags. We take advantage of both static and dynamic redundancy existing in CAN bus traffic, eliminating the need for extra bandwidth.

A mathematical proof of the security level of our AE (Authenticated Encryption) scheme is presented, showing that both confidentiality and authenticity are included.

No changes to the application code, protocol or chipset are entailed, and runtime key exchange is not required. In addition, any type of serial data bus can be secured by IVAS, so that varied ECUs can work together.

The IVAS solution for securing the CAN bus stands out in its ability to authenticate sender integrity and data integrity, blocking malicious messages without adding payloads.

Assaf Harel, Karamba Security; Amir Hezberg Ing, University of Connecticut

Wednesday, January 16
**Tele-operations and remote monitoring for safe autonomous vehicles**

In the future, highly autonomous driving will be safe, convenient, affordable and available for all. However, the road to this future includes many hurdles and the transition to this safe and convenient future is challenging. One such challenge is that AI cannot yet handle all the scenarios that the vehicle may encounter, for both Fully Autonomous Vehicles (SAE L4/L5) as well as Highly Autonomous Vehicles (SAE L3).

In edge cases when an autonomous vehicle enters a situation its AI cannot handle, dynamic control will revert to a remote operator. For such scenarios, a support center will assist the vehicle’s AI in understanding the environment to resume driving safely. Such support requires ultra-reliable connectivity of high-quality video feeds from car cameras, as well as data from sensors and telemetry to be sent in real time to the control center.

Testing and validating autonomous vehicles is also a challenging task. Safety drivers tire from the repetitive and boring task of verifying that the self-driving car is operating correctly. A remote tele-operations center can improve the quality of the monitoring in multiple dimensions.

While promises of 5G seem to provide high quality video with very low latency, coverage and reliability will remain a challenging task for the coming few years. LTE and even 3G will be required to complement 5G coverage.

In this presentation, we will cover the main use cases for tele-operations and remote monitoring, highlighting the benefits of each. We will also go over the various alternatives for providing a reliable high bandwidth connection to the vehicle.

Doron Elinav, LiveU

**Registration and Navigation Methods for Connected Cars**

Noam Meir, Eli Etkes Sons LTD

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**Wednesday, January 16**

**Mobility & ITS**

**Session Code:** ICAV500

**Room TBD**

This session focuses on smart mobility, including intelligent transportation, traffic modeling and optimization, demand-responsive public transit, ride-sharing models and on-demand mobility.

**Organizers** - Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

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It's a common assumption that in the future urban transportation will be taken over by Automated (driverless) Vehicles (AV) (Litman, 2017). Shared AV (SAV) are believed to become a major transportation mode. This belief is based on the popularity of Transportation Network Companies providing commercial ridesharing services, e.g. VIA, Lyft and Uber (Fleischer et al., 2018).

The modal shift from the current habitual travel behavior to SAV offers far-going improvements to road congestion, air pollution and traffic accidents (Fagnant & Kockelman, 2014). To estimate the consequences of the transition to SAV, we performed large-scale simulations of SAV usage in the Tel-Aviv Metropolitan area (TAM) using the MATSim simulation software (Horni et al., 2016). MATSim operates at the spatial resolution of a single street link, and building and enables assessment of SAV effects for each traveler. MATSim travelers follow their daily travel plans and can modify them (e.g., depart earlier, re-route, change mode) in order to minimize their travel time. To simulate AV-based ridesharing services we employ the demand-responsive transport algorithm which maximizes the SAV use (Bischoff et al., 2017).

The parameters of the simulation were calibrated based on the traffic counts in TAM, using (Flötteröd, 2009) approach and achieved high fit of $R^2 = 0.93$ between the simulated and real traffic counts.

The simulations demonstrate that the current number of trips in the TAM can be served by about a half of the current vehicle fleet. However, minimal possible fleet size entails long waiting time for an essential fraction of travelers. Waiting time decreases with the larger fleets, but this undermines the economic stability of the system. We thus anticipate that with the future shift to Mobility-as-a-Service (MaaS), SAV will be adopted as a new transport mode while by economic reasons other modes would not be displaced entirely.

Chanan Gabay, CG Smartech
Will Shared Automated Vehicles Resolve the Traffic Problems in the Tel-Aviv Metropolitan Area?

It’s a common assumption that in the future urban transportation will be taken over by Automated (driverless) Vehicles (AV) (Litman, 2017). Shared AV (SAV) are believed to become a major transportation mode. This belief is based on the popularity of Transportation Network Companies providing commercial ridesharing services, e.g. VIA, Lyft and Uber (Fleischer et al., 2018).

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Golan Ben-Dor, Itzhak Benenson, Tel-Aviv University; Eran Ben-Elia, Ben-Gurion University of the Negev

Sensible Vehicle Sharing Systems

The talk will review the success factors for car and bike sharing programs and will explain why some of these programs are bound to fail. I will discuss the merits and limitation of various network structures (round-trip versus one-way and free-floating) and examine the effects of the fleet size and the service area on the efficiency and the quality of the service provided by these systems. I will support my claims by the results of a large-scale numerical experiment conducted based on actual movement patterns of passengers in a metropolitan area.

Tal Raviv, Tel Aviv University
Ashdod Smart Mobility Living Lab

<p>Motivation: Similar to other cities around the world, Ashdod is experiencing an innovation momentum and is adopting smart city technologies, with a major emphasis on smart transportation. To maximize the full potential inherent in turning cities into smart cities, it is necessary to overcome a number of barriers: (1) The data currently gathered about the city is spread over different systems, some of which are under the public sector, but nearly all are under the private sector; (2) Small- and medium-sized municipalities lack the resources needed to process the information and draw conclusions from it; and (3) There is no easy way to test cutting-edge smart city technologies in real-life conditions.</p>

<p>Uniqueness of Ashdod: (1) Ashdod is a mid-size city located at the southern district of Israel. (2) Ashdod has the largest sea-port in Israel, therefore constituting a central transportation logistics center. A new and even larger sea-port is currently under construction. (3) Ashdod has a unique urban design consisting of 17 independent quarters. (4) Ashdod was selected by the Israeli ministry of transportation as a pilot city for the construction of a smart road for public transportation.</p>

The proposed solution: Set up a Living Lab dealing with smart transportation in the city of Ashdod. The Living Lab will rely on a unique platform for data collection and sharing that will facilitate the development of advanced technologies and their subsequent introduction into the city for testing and implementation purposes. The proposed information platform is founded on four principles: (1) gathering data from various information sources – both public and private; (2) extracting insights from the information by making it available to entrepreneurs and researchers; (3) improving present behavior by using the city as a Living Lab to test new technologies; and (4) maintaining confidentiality when sharing the information.

Erez Shmueli, Tel-Aviv University

Eliminating Congestion with Connected Vehicle Applications

Dov Ganor, Mobilityinsight

Wednesday, January 16

V2X

Session Code: ICAV600

Room TBD  Session Time:

This session will include a broad range of V2X, V2V and V2I communication topics, including system architectures, communication systems and antennas.

Organizers - Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

Time  Paper No.  Title
ORAL ONLY  

Deployment of Cooperative ITS services in Israel

<p>The Israeli Ministry of Transport conducts several activities to prepare the deployment of connected vehicles and C-ITS services.</p>
- Regulating the frequency range to be used for DSRC: a frequency band at 5.9 GHz of 10 MHz is already allocated to C-ITS;
- Minimum set of standards: this activity started already under the Standards Institute of Israel. Currently, and for the near future, only DSRC ITS-G5 will be mandated, since it is mature, standardized, and supported by many transport administrations, whereas LTE-V2X still requires standards and agreements. Services on cellular infrastructure such as WAZE, Moovit, and Pango will be defined by the service providers.
- Security services for DSRC: we intend to apply the Security Credential Management System based on PKI, according to the forthcoming EC delegated regulation (expected on November 2018).
- Transit Signal Priority demonstration project has already been started in Haifa;
- Red Light Warning System research project in Beer Sheba is in advanced stages of implementation, expecting tests to start soon.

C-ITS services that will be available for implementation on Day1 include only V2I services. The rational for this decision is:
- ITS communication stations penetration rate in vehicles will be low for many years; therefore, V2V services will not be effective.
- Due to privacy concerns, we shall support V2I services implemented by public authorities and fleet operators.

Here is a list of C-ITS services that we shall support on Day1:
1. Intelligent Traffic Signal System
2. Red Light Violation Warning
3. Transit Signal Priority
4. Traffic Light Optimal Speed Advisory
5. Roadworks Warning
6. Speed Limit Notification
7. In-Vehicle Signage
8. Automatic Access Control

Zeev Shadmi, Ministry of Transport and Road Safety

ORAL ONLY  

The future of V2X

The presentation addresses the current and future use-cases of V2X, the potential contribution to Automated Vehicles and Vulnerable Road Users safety. The global market trends are reviewed, ending with the Israeli market status.

Onn Haran, Autotalks
**ORAL ONLY**  
*DSRC vs. Cellular V2X “Who Will Prevail”*

Short range vehicle communication (V2X) is one of the promising technologies in the field of vehicle connectivity. This technology allows direct short-range communications between vehicles (V2V) and between infrastructure and nearby vehicles (V2I). The technology is mainly aimed at safety and traffic control applications but can also be the bases for a large variety of solutions. It is also a main building block for the future to come automatic (autonomous) vehicle technologies.

Recently, the industry is looking at 2 different technologies as possible solutions for V2X applications. The first is “DSRC” which is based on Wi-Fi protocols and the second is “Cellular V2X” which is a part of the LTE and 5G standards and protocols.

The lecture will look deeply into the 2 alternative technologies. Each technology will be described, and protocols, topologies and network architectures will be explored and presented. A technology-oriented comparison will be made between the competing solutions and commercial and policy aspects will be discussed and presented. Finally, a market status, trials and deployment will be presented.

*Israel Ronn, Logtel Computer Communications*

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**Wednesday, January 16**

**Vehicle Design**

**Session Code:** ICAV700

**Room TBD**  
**Session Time:**

This session covers a broad range of vehicle electronics and software topics, including in-vehicle network architecture, electronics, software, model-based design, over-the-air software update, and other vehicle architecture and design-related topics.

**Organizers -** Joseph Barkai, JBMCS; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

**Time**  
**Paper No.**  
**Title**
**Enabling PCIe Connectivity in the Car**

As the processing power within our cars increases dramatically, the utilization of server farm platforms services such as virtualization and resources sharing becomes more and more relevant and necessary. The ability to utilize native PCIe interfaces is a key factor to enable such capabilities and services. The ability to natively extend PCIe can considerably optimize in-vehicle connectivity. HDBaseT Automotive is the one technology able to extend PCIe for up to 15m, providing more flexibility and resource optimization. HDBaseT Automotive can connect CPUs to CPUs, providing redundancy, and TCUs to head units and gateways. HDBaseT Automotive enables the use of PCIe beyond the board boundaries, and it is the only technology that can multiplex both PCIe and Ethernet over the same link. HDBaseT Automotive brings a dedicated protocol stack for handling high-throughput, time-sensitive applications, enabling true multi-Gbs networking of packet data for different type of applications, including real-time data, video, audio, USB, and controls, over 15m of a single unshielded twisted-pair (UTP) cable, or any other commonly used media (such as STP, HSD, coaxial and fiber). To realize the potential of the connected and eventually autonomous cars, new in-vehicle connectivity technologies must be adopted, enabling more bandwidth, more devices, and more architectural flexibility. We are at a tipping point in the market. HDBaseT Automotive is a flexible technology that provides increased benefits (convergence, simpler cabling, EMC robustness, high bandwidth), simplifying this shift and optimizing the scalability and adoption of new devices. New connectivity architectures are needed to support the way to autonomous driving and PCIe is a key factor here.

Sandra Welfeld

**Pedestrians’ Understanding of Fully Autonomous Vehicles’ Intention: a Proposed Framework**

Crossing the street in the Autonomous vehicle (AV) era will be different from the crossing today since, among other things, crossing intention of pedestrians will no longer be influenced by informal pedestrian - driver human-human communication (such as eye contact, facial expressions, gestures, or body movements).

New considerations and new elements, relating to the interaction of AVs and pedestrians will come into play. Primarily, pedestrians' understanding of AV intentions and their ability to predict its behavior and vice versa, AV's ability to predict pedestrians' intent. To accomplish better understanding, AV developers will need to design compatible interaction systems that will assist pedestrians to trust and intuitively understand the AV's intention, as well as predict its behavior. Human factors engineers must be included in the design phases of this interaction, in order to examine the influence of the various interaction parameters on pedestrians' understanding, crossing decisions, and safety.

In the current study, we focus on one of the fundamental parameters that influence the pedestrian - AV interaction, which is the modalities of display of the AV interaction system (i.e., how the information will be displayed). In addition, we examine the importance of AV transparency level (i.e., the level of information that the system provides to the pedestrian - depth of the information displayed) to pedestrians' situational awareness and intentions to cross. A framework to examine the influence of transparency level and modality type on pedestrians understanding and intention.

Based on this framework, a series of experiments will be conducted in the Dome pedestrian simulator at BGU. The anticipated outcome will be a set of design recommendations for interaction that will improve pedestrians' understanding and intention to cross in safe situations when crossing in the AV world.

Michal Hochman, Tal Oron-Gilad, Ben-Gurion University of the Negev; Hagai Tapiro, Oregon State University
**Wednesday, January 16**

**Day One - Plenary**

**Session Code:** ICAV800

**Room TBD**

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<td>ORAL ONLY</td>
<td>Chairman Welcome and Remarks</td>
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<td>Joseph Barkai, JBMC</td>
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<tr>
<td>9:25 a.m.</td>
<td>ORAL ONLY</td>
<td>Keynote Presentation: Preparing for the Coming 5G Tsunami</td>
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<td>Roger Lanctot, Strategy Analytics Inc.</td>
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**Written Only**

**Session Code:** ICAV900

**Room TBD**

**Organizers** - Joseph Barkai, JBMC; Ilit Oppenheim, Tel Aviv University; Israel Ronn, Logtel Computer Communications

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<td>Instantaneous Driver Safety Assistance and Rear Wheel Maneuvering system based on Computer Vision</td>
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<td>2019-01-0096</td>
<td>A Comparison Between Coupled and Decoupled Vehicle Motion Controllers Based on Prediction Models</td>
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<td>Jose Angel Matute, Ray lattarulo Ing, Tecnalia; Asier Zubizarreta, University of the Basque Country; Joshue Perez, Tecnalia</td>
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