Abstracts de la conférence SMIV 2017
SESSION 1: PEDESTRIANS AND AUTONOMOUS VEHICLES

Detection, Tracking, Physical and Sociological Interactions with Autonomous Vehicles
**Titre** : Pedestrian detection and AI: new AI methods  
**Orateur** : Thierry Chateau, Pr, researcher in Computer Vision  
**Affiliation** : Institut Pascal

### Résumé / Abstract

Recently, tracking-by-detection techniques have gained significant interest in the research community and it becomes more and more popular for visual multi-object tracking applications. However, it requires reliable and accurate detector in order to acquire good results. Deep learning techniques have achieved the state-of-the-art performance in several computer vision applications such as object detection, semantic segmentation, and object tracking. This presentation will focus on recent works using Deep Convolutional Neural Networks for pedestrian detection and tracking. Popular detection networks like Faster-Rcnn or SSD will be presented. A domain adaptation algorithm will be introduced and evaluated on several public datasets. Extension to Multi task networks with the recent DeepManta network will be also presented. Tracking improvement will be proposed using an original video interlacing strategy.
Titre : Pedestrian detection and behaviors modelling in Urban environment
Orateur : Dominique Vaufreydaz, Maître de Conférences en Informatique
Affiliation : Université Grenoble Alpes/LIG/Inria

Résumé / Abstract
Research on autonomous cars has made great strides in recent years. There are even production vehicles that can drive autonomously alone on highway-style lanes. However, there is few researches on a facet of these autonomous vehicles: the future sharing of city centers between users (pedestrians, cyclists, public transport) and autonomous vehicles. In this context, it is necessary to take into account the typical nature of these environments and the associated behaviors in order to allow everyone to circulate gently and safely. There are still a number of areas for improvement for autonomous driving systems in the city center. Perception is one of the issues around the autonomous car. Advances in Deep Learning and embedded computing boards are expected to deliver good performance of the underlying algorithms. Future autonomous systems must be able to detect and distinguish pedestrians, cyclists and other mobile obstacles. There is also a need to understand the full scene: side walk, cross-walk, buildings, region of interest, direction of traffic, etc. To fulfil the global view, it is mandatory to include the feelings of passengers of the autonomous vehicle. These inputs will serve to predict and anticipate environment around the car. The resulting behavior of the autonomous vehicle should be readable for other users of the urban centers.

In this presentation, we will focus on detecting and predicting pedestrian behaviors around autonomous vehicles in city centers. We will describe the perception/prediction/decision/action loop that must prevail when moving autonomous vehicles. We will present the possibilities offered to us using knowledge from the cloud (maps, shops’ position, …) coupled whether ego-centered perception on the vehicle or a mixed eccentric perception using the capacities available in urban centers (cameras, IoT sensors, etc.). Based on this information, our system proposes the online construction of a local model of the environment. Using Natural Vision principles, the system then predicts behaviors of pedestrians to increase situation awareness of the autonomous car.
Résumé / Abstract
Pedestrians located far ahead of an autonomous vehicle in its line of sight are important subjects for object detection. Successful detection of such “far-away” pedestrians increases the range over which the vehicle can be relied upon for successful navigation and autonomous control. “Far-away” pedestrians appear small in height and are sometimes difficult to distinguish from surrounding entities in a road-environment. Successful detection in such scenarios is invaluable also for surveillance cameras installed on crossroads. Crossroad cameras having detected “far-away” pedestrians can improve inter-vehicular communication and thus improve the coordination between autonomous vehicles in a road environment. Despite rapid advances in the field of pedestrian detection, similar advances and studies focused on “far-away” pedestrians are generally sparse. In our work on pedestrian detection we emphasize on detecting such “far-away” pedestrians with the objective of increasing the safety of autonomous vehicles in a dynamic road environment. It is shown that “far-away” pedestrians generally are distinguished from “close-range” pedestrians through very different visual features. We propose a neural network based approach which unifies the detection of “far-away” and “close-range” pedestrians within a single framework. Our experiments and analyses in progress, suggest that the proposed approach is able to alleviate the problem of “far-away” pedestrians. We present our results on the public benchmark dataset of “caltech pedestrians” which shows a promise of our approach in countering the problem of “far-away” pedestrians in a road environment. Our first results illustrate a competitive performance on “caltech pedestrian” by detecting people above the height of 50 pixels with a miss-rate of 13.98%. People below the height of 50 pixels were detected with a miss-rate of 31.73%. Further experiments with refining various system parameters are likely to improve these results. The presentation will focus upon the problem of detecting “far-away” pedestrians and highlight other practical challenges which need a greater focus by the research community. This will illustrate a holistic view of the detection scenario of an autonomous vehicle in a street environment. In addition, it will provide a ground for discussion about how far we are with respect to adopting autonomous vehicles in our transportation system.
Titre : A dissociation between sensorimotor and cognitive processes during pedestrian path planning
Orateur : Halim Hicheur, PhD, researcher in Behavioural Neurosciences
Affiliation : Independent researcher

Résumé / Abstract

Information processing in the brain of living systems is a question which received considerable attention in a variety of traditional and more recent research fields (e.g. psychology, biology, but also neurosciences, robotics, computer science...). While the outcome of these studies provided fundamental insights into the understanding of cognitive processes in humans, most of them were performed in environments with static (standing or seating) participants. This talk will mainly focus on how cognitive and motor processes interact in walking people performing simple goal-oriented tasks. While these daily tasks are performed effortlessly, they all rely on particular types of processes: encoding/knowing where we are, planning where we go and how to go there. We will present theoretical and experimental studies performed in healthy and disabled people over the past ten years. In particular, our detailed analysis of the whole-body trajectories provided interesting findings showing that despite different types of sensorimotor deficits/conditions, human beings produce stereotyped trajectories during spatially-oriented locomotion. This suggests that pedestrian path planning can be dissociated in distinct cognitive and sensorimotor components. We will discuss the potential neuronal structures involved in human locomotor planning and how this type of knowledge can be integrated in real pedestrian environments.
Résumé / Abstract

The good interaction between pedestrians and automated vehicles will be a milestone in the acceptability of these new vehicles by the general public. To ensure this beneficial cohabitation, the automated vehicle should be capable to offering the pedestrian a safe and non-uncertain street-crossing. Although the decision to cross the street is well documented, it is necessary to merge the knowledge within a global and representative analysis in a natural environment, taking into account a more detailed conception of the steps of decision-making. Indeed, more than the detection of a pedestrian on the road, the research and development of automated vehicles should include a detection of the street-crossing intention, avoiding thus recurring emergency braking in the urban flow. In this context, a first study was carried out in a natural environment, involving 20 participants with a total of 73 analyzed street-crossings in conventional urban traffic organized around two defined routes. A triangulation of methods, coupling elicitation interview method, video recordings and questionnaires about pedestrian habits, was preferred to access to the pre-reflective elements of the street-crossing decision-making and thus to obtain a complete subjective and objective set of data. Moreover, half of the participants were instructed to perform the chosen routes under time pressure because of its well-known impact on the decision-making process. The analyses aimed at extracting the processes of street-crossing decision-making (i.e., perceptual elements, cognitive activities, emotion or internal states and actions). The results highlighted three different situation types: street-crossing situations without traffic, non-risky situations with traffic and risky street-crossing situations with traffic. Some identical patterns of street-crossing decision-making were detected. They were modulated by socio-cognitive factors such as, for example, the influence of other pedestrians or assessment bias of the vehicle behavior. For the risky street-crossing context, data showed a great impact of the time pressure and the risky behavior habits. The presentation will focus on this important result that is the most complex situation to detect for the automated vehicles. It will also illustrate the interest of the used method to both better understand and anticipate in the future the risky street-crossing by improving the algorithms of the automated vehicle for the detection of pedestrians and by providing adapted external communication.
Résumé / Abstract
As Vulnerable Road Users (VRU) represent a large amount of traffic injuries and fatalities, improving their safety is major topic with the Intelligent Transport Systems (ITS). To avoid accident with VRUs, vehicles can trigger emergency braking or evasion maneuvers when a collision point is detected in its near future trajectory. A key aspect to establish the existence such collision point is to correctly detect and localize the VRUs who are in the surroundings of a given vehicle. The existing R&D efforts on this subject are mainly based on perception techniques, which aim to detect VRUs utilizing vehicle embedded sensors. The efficiency of such a technique is largely affected by the sensor’s visibility condition. Vehicle-to-Pedestrian (V2P) communication can also contribute to the VRU safety by allowing vehicles and pedestrians to exchange information using wireless communication. This solution is, however, largely affected by the reliability of the exchanged information, which most generally is the GPS data. Since perception and communication have complementary features, we can expect that a combination of such approaches can be a solution to the VRU safety. This is the motivation of this work. We propose a cooperative system that combines the outputs of communication and perception. After introducing theoretical models of both individual approaches, the cooperative system is develop using a probabilistic association between perception and V2P communication information. Our results show that the perception system reliably detects pedestrians and other objects within 50m of range in the line-of-sight (LOS) condition. In contrast, the V2P communication coverage is approximately 340 and 200m in LOS and non-LOS (NLOS) conditions, respectively. However, the communication-based system fails to correctly position the VRU with respect to the vehicle, preventing the system from meeting the safety requirements. Finally, we establish that the performances of the cooperative system are influenced by the classification performance of the perception system and by the accuracy of the GPS positioning for the communication system.
SESSION 2: BIG DATA AND NOVEL MOBILITIES

Challenges on Big data collecting, analysis and associated Learning Methods
Titre : Introduction to Deep Learning. Illustration on Smart Mobilities applications
Orateur : Ludovic Denoyer, Professor
Affiliation : University Pierre et Marie Curie (UPMC / LIP6)

Résumé / Abstract

The last few years have been marked by the explosion of the quantity of temporal data in various fields such as meteorology, biology, automobile traffic and finance among others. In the smart mobilities domain, most of the data are produced in the form of time series that are most often multi-varied and exhibit spatio-temporal dependencies. This is especially true in the transport sector, where the development of Intelligent Transportation System (ITS) systems, which require the collection of information on traffic and road infrastructure in real time, is booming. For several years now, in order to improve road traffic conditions and fluidity, data collection methods have evolved considerably and access to real-time traffic information has become commonplace. Static (cameras, magnetic loops) and mobile (GPS embedded in vehicles or smartphones) sensors capture the evolution of urban activity in real time.

In parallel, in the machine learning/artificial intelligence community, the deep learning methods had a very strong impact and are now at the source of many successes in different domains like computer vision, natural language processing, etc...

In this talk, I will first propose an overview of deep learning methods, explaining the general principles of such approaches. I will then present a recent work made in collaboration between UPMC and VEDECOM on the problem of car traffic forecasting with spatio-temporal neural networks.
Résumé / Abstract

The context we focus on is the definition of a global urban numerical architecture dedicated to mobility, i.e., a dynamic digital twin of the city avoiding the logic of application « silos ». The objective of such a digital application is:

• To understand urban mobility (a unique digital observatory of mobility): new social and usage indicators, mobility practices, their positive and negative impacts on inhabitants (uses, chosen or experienced mobility, health, disability situation), sociology of population (labor mobility, trade and delivery, leisure, access to public services, ...), links between mobility, activities and territories organisation, multimodal uses.
• To enable agile and coordinated governance of mobility means and infrastructures; to size and optimize the deployment of new equipment and mobility infrastructures.
• To invent and support new uses of mobility thanks to digital technology; sociology and new relationships of citizens to mobility, collective intelligence, legal evolutions, new organizations of territories and activities.

In this context, we shortly present four research activities within DAVID laboratory:

• Safety approaches for the modeling and generation of scenarios of dangerous situations for the deployment of autonomous vehicles (Collab. DAVID - IRT SYSTEMIX)
• Machine learning for urban parking assistance by a large-scale modeling of parking capacity and resources (Collab. DAVID – Védécom)
• Management and data mining for the analysis of urban mobility trajectory
• Distributed vehicular traffic re-routing systems for congestion avoidance

Institut de VeDÉCOM
Titre : Data collecting and processing for autonomous driving applications
Orateur : Steve Pechberti, PhD, researcher in machine intelligence
Affiliation : Institut VEDECOM

Résumé / Abstract
The definition of an autonomous vehicle mainly relies on its capacity to collect and process information. Many issues derived from this simple assertion. All collected information have not the same framerate inside the data acquisition pipeline, the information provided by sensors are not always directly useable by the processing pipeline and require transformation which have to be realized in real-time to keep information reliable enough to be used by the algorithms embedded in the AV and control it. Depending on the objectives, it is sometime also requested to collect and store these information for further usage.

This talk will present an overview of the different point that have to be taken into account to fullfil the data analysis requirement for AV.

It then presents a collaborative experiment realized at VEDECOM between VEH and MOB about the pedestrian behavior prediction which will illustrated all the previous aborded aspect of data acquisition and processing.
Titre : Trusted and Secure Communications in Vehicular Mesh networks
Orateur : Jun Zhang, PhD, researcher in Wireless networks and security
Affiliation : Télécom ParisTech

Résumé / Abstract
In recent years, Vehicular Ad-Hoc Network (VANET) has gained much attention in research community so much so that a standardization body called the Cooperative-Intelligent Transportation Systems (C-ITS) has been established to look into extending the VANET applications beyond road safety and traffic management. Under this new initiative, C-ITS aims to provide other value-added services such as infotainment, downloading of the nearest point of interests and Internet provisioning applications. To support this notion, VANET has been integrated with Wireless Mesh Network (WMN) due to its low deployment cost and high interoperability with other communication technologies. However, this integration gives rise to node cooperation issue because of the multi-hop communications. In addition, the traditional security solutions ordered by public key cryptography in conjunction of a Public Key Infrastructure (PKI) may not be effective due to the short connection times and the dynamic nature of the topology caused by the high mobility of vehicles. These unique challenges motivate the research on trust and key management systems. We focus on these two research areas to provide trusted and secure communications in a vehicular environment. In trust modeling, we propose a trust model called the Dempster Shafer-Trust (DS-Trust) model to handle badmouthing attacks and ballot-stuffing attacks, and a novel trust model called the Merkle Tree-based with Reinforced Overhearing (MeTRO) to handle limited transmission power attacks and packets modification attacks. Furthermore, we propose an efficient key establishment protocol, Secure and Authenticated Key Management Protocol (SA-KMP), to reduce the excessive dependence on the PKI.
Titre : Data Modeling used in perception algorithms
Orateur : Gildas Thiolon, Data Science Engineer
Affiliation : Institut VEDECOM

Résumé / Abstract

Introduction. The knowledge of the real world driving environment for current road vehicles is fundamental in order to better identify safety problems encountered by autonomous vehicles in similar complex situations. In order to acquire this knowledge VEDECOM leads the MOOVE Project, whose objective is to acquire data with smart sensors on specific equipped vehicles, recorded over more than 12,000 driving hours and 500 000 km. To be analyzed, such a quantity of raw data must be indexed following driving scenarios. The objective of this study is to design a structure for this big data which respects the original output of sensors and enables large scale analyze of real driving situations.

Methods. First, to build this database we must decode data from raw sensor outputs. Every sensor data is extracted independently according to constructor’s Data Base Connection (DBC). Synchronization between sensors is ensured by acquisition software which records timestamp of every sample. Information about road infrastructure is obtained through map matching, results are then injected in data as a new sensor.

Next, we structured the decoded data following a schema which is compatible with a relational database. Through configuration files we can ensure the replicability of model among acquisitions and qualify the data based on statistical indicators tests computed for each signal. Each synchronized signal is associated with a unique timeseries which itself is related to an elementary component, named data segment. Special feature of smart sensors is to record concurrently several measurements. A multiplexing signal is generated in order to store data from smart sensors.

Finally, this database allows data inquiries while extracting signals, used as input in perception algorithms. Outputs of algorithms are stored as new elements in the database.

Results. Through these 3 steps we have a process allowing us to define an evolving schema from raw sensor outputs to a structured Relational Database. This process has been developed and tested to run 100 % of the data we acquire, with enhanced performance.

Conclusion. This Relational Database allows us to model our data from complex perception of the environment. For each used case we will be able to analyze sensors’ behavior, test real time perception algorithms and simulate control mechanisms of autonomous vehicles and therefore improve the safety of such vehicles.
**Titre**: Mobility Analysis in Public Transport with Smart Card Data

**Orateur**: Latifa Oukhellou, Directrice de recherche

**Affiliation**: IFSTTAR

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**Résumé / Abstract**

Traditionally, the analysis of mobility is based on travel surveys (Household Travel Surveys (HTS), origin-destination surveys, cordon line surveys...). The analysis of daily travel can also rely on the increasing number of digital records that are generated during our trips. We currently have many sources of data, for example ticketing data, GSM Wi-Fi or Bluetooth records and the geo-positioning of posts on social networks that are generated during our trips. Although the devices in question were not initially designed for the analysis of mobility, there usefulness is obvious. The digital records they generate can be used to implement new modelling approaches for urban mobility. In the particular case of public transport, smart card data change the methodological context within which the modelling problem is considered, in particular for the description of mobility and the observation of multimodality and intermodality. These data have a number of valuable intrinsic advantages: the observation window for trips is wide, and almost continuous; the information that is collected is distributed along the network. Nevertheless, their use raises a number of issues and challenges: Missing data, for systems like the Metro or bus, only trip origin data are available (users stamp their ticket only on boarding), the extremely large volume of data involved (approximately 10 million tickets are stamped on every working day in the greater Paris region) and on the grounds of personal privacy, no socio-economic data on the user is available. 

In this presentation we will focus on data analytic tools that are built to enhance our knowledge of the mobility of individuals by using ticketing data, supplemented by, for example, socio-economic, geographical or event-based contextual data. By using the analysis of quantitative data (Data Science) the goal is to propose decision-making aid tools for analytical, forecasting and display purposes in order to gain a better understanding of urban mobility as well as of transportation systems by asking a fundamental question “What do these data tell us about our mobility and about our cities?”. 

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02/11/2017
Titre : Legal requirements for personal data protection
Orateur : Myriam HOEFFLER, PhD student in private law
Affiliation : Institut VEDECOM

Résumé / Abstract
As every connected objects, automated vehicles collect and process data for their operation and the services they provide. These vehicles may also be equipped of a data recorder, i.e. a system assigned to store relevant data in case of an accident or a road event. These data are likely to be related to a physical person and therefore fall within the scope of personal data regulation. During the last decade, the amount of personal data processed and exchanged increased dramatically, raising new legal challenges. These data acquired a huge market value and are now crucial to many business models in the digital market, but they also raise important privacy issues. In Europe, the legal framework ensuring personal data protection recently evolved with the adoption of the General Regulation on personal data protection on 14 April 2016. This Regulation will replace the current Directive (Directive 95/46/EC) and will be directly applicable in all Member States on 25 May 2018. It pursues a double goal of strengthening the European citizens’ right to privacy while ensuring the competitiveness of European companies on the international market. We will expose the main provisions set by the Regulation to achieve this goal. These provisions are general and shall apply whenever personal data are collected and processed in the European Union or by a company established in the European Union. While the rights of the data subjects shall be reinforced, companies will have to comply with strengthened requirements, among them the necessity to obtain the consent of the person before collecting or processing his/her data. It also implies that transparent information shall be provided in order to obtain the free consent of the person/consumer. Besides, safety measures shall be provided to secure the whole data processing according to the privacy-by-design principle set by the Regulation, which requires that the products and services offered are programmed by default with the most protective security parameters. Furthermore, we will analyze how these general requirements specifically apply to the personal data processed by automated vehicles. Combined with their innovative technologies, implementation of privacy measures shall ensure safe drive for the future users and buyers of these vehicles.
SESSION 3: EXPERIMENTATION & VEDECOM DEMONSTRATIONS

Autonomous Vehicles Experimentation Trends
Titre : Ambarella/VisLab perception technology for Autonomous Driving
Orateur : VisLab General Manager, Italy
Affiliation : VisLab, an Ambarella Company

Résumé / Abstract
In recent years we witnessed an explosion of interests around intelligent vehicles, in particular for autonomous driving. Starting from precompetitive research 20+ years ago, many experiments have been organized to fully understand the requirements and the corner cases to be addressed in the development of an intelligent vehicle.

One of the most important aspects of an autonomous vehicle is its capability of perceiving and interpret the surrounding environment. Many sensing technologies have been proposed and implemented to provide the vehicle with a synthetic representation of the world around it, including sonar, radar, and lidar, but it's only in recent days that vision is showing all its potential.

Current imaging technologies allow to overcome the major problems that slowed down the deployment of vision in previous years: ultra high resolution images, acquired at high frame rates, in highly dynamic conditions like night scenes with headlights or daylight scenarios with direct sunshine and shadows are now available at a low cost. At the same time, the latest developments in deep learning provided a boost to computer vision as the main means to recognize objects and scenes.

The talk will present the latest developments in chip design that provide a low cost, low power, and highly effective solution to visual perception. The new Ambarella chip for the automotive market will also be described.
Titre : Fusion multi-capteurs pour la détection et le suivi d’obstacles
Orateurs : Emmanuel Doucet, Hatem Hajri, Hoang-Lan Pham
Affiliation : Valeo, Institut VEDECOM, Transdev

Résumé / Abstract
If autonomous vehicles are to fulfil society’s expectations, they shall be able to navigate complex and highly dynamic environments in a safe and efficient manner. This problematic encompasses several current research topics of the Institut VEDECOM autonomous vehicle research team, such as road users intention prediction, route planning, navigation and obstacle avoidance, all of which require a robust and reliable perception of the environment and of potential obstacles. Although some industrial grade systems providing such functionality are commercially available as of yet, most of them were designed to be used in highway environments, and their performance in urban situations is often degraded. In this context, a study was conducted to develop a new LIDAR-based obstacle perception and tracking solution, which was coined DeTrOLI. The method we propose is built upon a Delaunay triangulation-based segmentation algorithm using a novel graph trimming methodology, and a modified Hungarian algorithm-based matching procedure. In parallel, a high-level multi-sensor objects fusion algorithm was developed to take advantage of each sensor’s specific ability to accurately measure various subsets of an object’s dynamic state. The level of performance of these methods was evaluated during two experiments conducted on closed tracks by simultaneously recording the position of two vehicles performing various manoeuvre scenarios while being observed by one another’s sensors. From these accurate geo-positioning recordings, a ground truth of the target vehicle position and dynamics was generated in the observing vehicle frame of reference. This ground truth was then used as a reference to evaluate the perception accuracy of various perception systems, and was used to compare their performance to that of the methods we developed. In terms of stability of the detection of obstacles, our proposed method outperforms all the methods it has been compared to, be it the algorithm embedded in the RADAR sensor we used, the LIDAR-based industrial grade obstacle detection and tracking system installed in the test vehicles, or the fusion of both using the proposed fusion method. The only instances where the identifier of an object is changed correspond to instants at which the obstacle was not detected at all by the LIDAR system. However, as to the accuracy of position and dynamics estimation, our method currently underperforms the industrial system of reference, thus highlighting the need to develop robust position and velocity observers.
Titre: Visualize heterogeneous data from autonomous vehicle for perception algorithms elaboration.
Orateur: Gildas Thiolon, Data Science Engineer
Affiliation: Institut VEDECOM

Résumé / Abstract

Objectives of the MOOVE Project

1- Identifying and analyzing real world driving situations leading to safety critical scenarios (SCS) for an Autonomous Vehicle (AV)
2- Quantifying the dimensioning parameters relating to the surrounding environment and dynamics and enabling the extraction of the SCS
3- Doing statistics about the occurrence of SCS
4- Identifying performance criteria to improve the AV perception and supervision systems
5- Setting up a database to be used in simulators

Data Analysis Methods

Extract autonomous vehicle's data from database

Use extracted data in perception algorithms

Visualize algorithm's output and vehicle's environment from sensors data
Titre : Wizard of Oz vehicle : a mobile laboratory for automated driving studies
Orateur : Mercedes Bueno Garcia & Ebru Dogan, human factors researchers
Affiliation : Institut VEDECOM

Résumé / Abstract

The Wizard of OZ is an instrumented vehicle that enables simulation of automated driving in a wide variety of scenarios. The main aim of this vehicle is to investigate driver behavior in ecologically valid, safe, and cost-effective automated vehicle studies.

The vehicle can be controlled in a classical way, that is, by the steering wheel on the left, as well as by a hidden joystick installed on the right side. A co-pilot, a professional or trained pilot, can handle lateral and longitudinal vehicle control by means of the joystick, pretending as if it is an automated vehicle. An additional role of the co-pilot is to supervise the vehicle and to guarantee safety in case of danger.

Several screens have been installed in the vehicle in order to study human-machine interaction. A tactile screen installed on the central stack serves two purposes. First, it allows us to communicate information relevant for vehicle state, such as driving mode, speed, remaining time in the automated driving mode, and activation/deactivation button to control automated mode. Second, it serves as an infotainment system including the multi-media functions, such as games, videos, internet, and emails. A second, smaller screen is installed on the bottom-right corner of the dashboard. This screen represents the current driving mode to make sure that this information is available to driver at all times, for instance, while looking straight ahead.

The Wizard of OZ vehicle has already been used in several experiments carried out by VEDECOM on a test track. The objectives of these experiments were to improve our understanding of driver behavior in an automated vehicle and to examine the interactions between pedestrians and automated vehicle. The next step in our research is to perform experiments on public roads.

The Wizard of Oz vehicle also intended to be used for pre-regulatory and pre-normative work in order to improve the conception of automated vehicles.
Résumé / Abstract

The Altaïr Project is an original idea drawn from the scientific research project Norm-Atis funded by ANR. Our demonstration presents a mathematical model of heterogeneous data fusion. This is a collaboration between the VEDECOM Institute, the University of Technology of Belfort-Montbéliard, and MediAmobile. The project is supported by a cross-fields work team with expertise in areas such as mathematics, statistics, computer science, cartography, human mobility and design.

Interoperability of heterogeneous mobility data

Our model of mobility is based on a combination of different types of data such as floating car data (FCD), demography, transportation networks and cartography. Our main goal is to make different kind of data interoperable. Once the data collection from ours partners and open sources is done, the process of machine learning is launched.

Data fusion

Our methods focus on knowledge fusion rather than data merging. In fact, data from different online surveys are not provided by the same individuals, therefore, it is not feasible to align different sources in the same data frame. On the other hand, each source contains information that may be extracted and then used to build a multiviews estimation. For instance, surveys data underline statistical links between individual attributes, land use data and mobility patterns. This knowledge is then transferred to census data using deep learning models. Thus, complete OD matrices may be built by fusing recent demographic information with historical surveys.

Outputs

We created a visualization tool as a way of illustrate our databases. The tool contains OD matrices shown as choropleth map with charts about gender, age, socio professional categories, modal shares and travel purposes on a typical day of the week per each half-hour of the day (48 time slots). Our tool is different from other tool as it can offer several unreleased travel purposes such as leisure or shopping. Furthermore, the tool also includes the traffic assignment for each OD query and provides the main and second most used paths.

What we offer

We are able to provide databases of human mobility. We are also ready to propose a consulting and studying expertise in transportation and mobility.

Future steps

To conclude we must remember that the Altaïr Project is a work a progress. This is only an alpha version of our work. There are many more possibilities to come in the following months (e.g., the integration of new data sources, new travel purposes, the improvement of the spatiotemporal granularity of our data model and of our prediction rates).