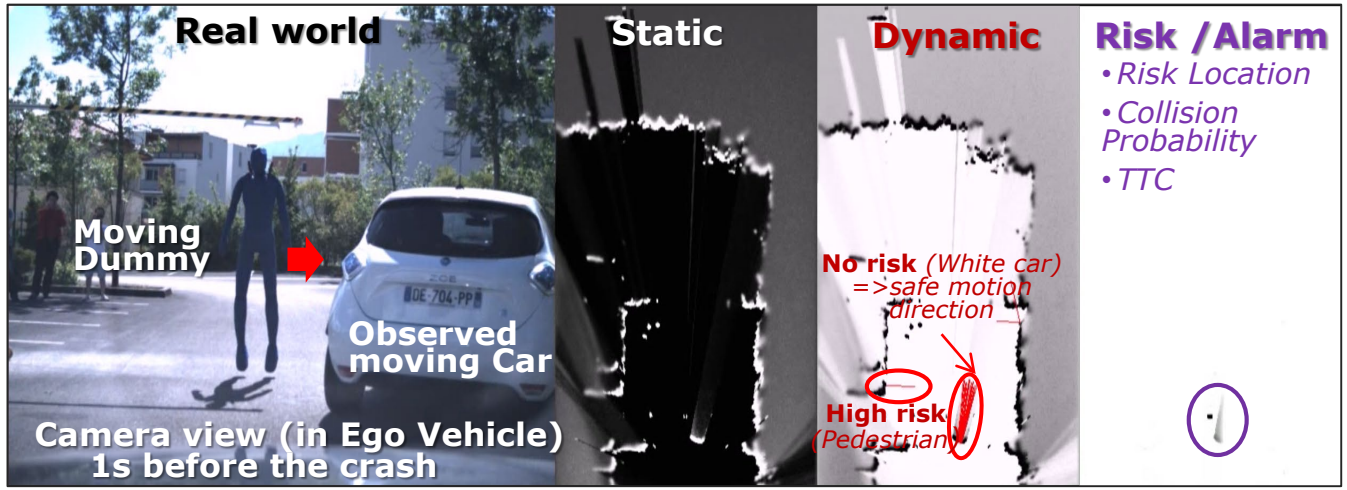
Title : "Dynamic scene understanding: analysis, prediction and collision risk assessment"
Speaker : Dr HDR Christian LAUGIER, Research Director at Inria & Scientific Advisor for Probayes SA and for Baidu China
Affiliation : INRIA & IRT Nanoelec

Abstract

Motion Autonomy and Safety issues in Autonomous Vehicles are strongly dependent upon the capabilities and performances of Embedded Perception and Situation Awareness systems. Recent benign and severe accidents (e.g. Tesla or Uber) have shown that the level of safety obtained using currently tested autonomous driving systems is still insufficient. This talk discusses these important perception and safety issues, and present how they can be addressed using a Bayesian Sensor Fusion approach. It will be shown how such a system (1) represent a dynamic scene using free, static, dynamic and unknown components, (2) predict upcoming changes in the scene, and (3) estimates short-term collision risks (about 3s ahead). Such an approach has been developed and patented by Inria and IRT Nanoelec, and it has recently been transferred to Toyota and to EasyMile.



Title :Pedestrian kinematics while crossing the street

Speaker : Jean-Louis Honeine , Research engineer in Human Factor at VEDECOM
Affiliation : Institut VEDECOM

Abstract

Automated vehicles will most certainly interact with pedestrians while navigating in urban environments. Such self-driving vehicles are expected to avoid pedestrians at all cost while enhancing traffic. Unfortunately, pedestrian behavior is stochastic. This renders the estimation of pedestrian intention using embedded systems very complicated. However, it has been shown in the motor control literature that prior to executing a voluntary movement humans need to perform postural adjustments ('postural set'). Detecting these postural adjustments could indicate for instance that pedestrians are planning to stop at the curb, accelerate, cross the street or change walking direction.

In this study, we recorded the kinematics of 15 pedestrians while crossing the street: kinematic measurements were obtained by positioning 17 inertial sensors were positioned on their body. To quantify those posture current study is the first to our knowledge to measure pedestrian kinematics while crossing the street. The volunteers were asked to perform two use cases: Forward Cross and Turn Right.

While crossing the street, pedestrians showed stereotypical motor behavior in both use cases. When stopping at the side of the street, pedestrians started decelerating at a distance of around two meters from the zebra crossing and executed at least three steps prior to stopping. Deceleration was produced mainly by means of reducing step length. When crossing to the right, participants started decelerating prior to rotating their body. Body and head rotations were in most cases very synergetic. While waiting at the curb, participants performed anticipatory postural adjustments in 86.5% and 47.1% of the trials for Forward Cross and Turn Right, respectively. Anticipatory postural adjustments were observed mainly as a hip abduction in the direction of the future stance leg and a whole forward body inclination. When crossing the street, pedestrians increased walking velocity until reaching steady-velocity at the third step. Acceleration was obtained by means of increasing trunk inclination.

In conclusion, the current study showed that prior knowledge about pedestrian motor behavior can be used to predict pedestrian intention. Therefore, it is highly advisable to develop algorithms capable of detecting such postural sets from the embedded systems' perspective in order to enhance the vehicles decision process while interacting with humans.

Title : Autonomous vehicles: the work done so far and the remaining challenges.
Speaker : Denis GINGRAS, LIV director at University of Sherbrooke
Affiliation : University of Sherbrooke, Canada

Abstract

While automated driving capabilities are being demonstrated through various pilot projects across the world, many questions remain, as most countries are affected by a wave of enthusiasm, mingled with fears, following some dramatic accidents. It is therefore useful to step back and take a good look at the work accomplished so far and the challenges that are still to overcome. It is also sensible to review the relevance of fully autonomous vehicles in various contexts. The pace at which manufacturers are implementing various automated driving features is impressive, but their specificities and their current limits force us today, from a technological point of view, to focus on the problem of generalization and standardization for mass production as well as reliability and robustness. To achieve reliable and robust driving automation and go beyond the performance of human driving, regardless of the driving scenarios and conditions, several major breakthroughs are still necessary, particularly in the field of artificial intelligence for perception and for the decision-making processes. The complexity of those systems also becomes a major concern, which affects reliability and costs. The tools and standards for the development, mass production, validation and maintenance of autonomous vehicles are yet to be developed in order to make them accessible and sustainable for solving, at least in part, the mobility problems we are facing. Beyond some of the technical considerations mentioned above, I shall also briefly discussed in this presentation the question of risk assessment and road safety metrics for social acceptance.

Title : V2X communications for connected automated mobility
Speaker : Dr. HdR Oyunchimeg SHAGDAR, Research & Project leader
Affiliation : Institut VEDECOM

Abstract

Research, development, and standardisation activities on vehicular communications technology have been carried out over the last decades for improved road safety and efficiency. Field trials demonstrated the feasibility of the so-called Day-One applications. Meanwhile, the autonomous vehicles technology made a spectacular progress presenting new applications with the demand of ultra-reliable and low latency secure V2X information exchange. This talk will present the *status quo* of the vehicular communication solutions and the key challenges and opportunities of the new generation V2X solutions for connected automated mobility.

Title : Predicting other road users' maneuvers for autonomous driving
Speaker : Dr. Vincent JUDALET, Researcher
Affiliation : Institut VEDECOM & ESTACA

Abstract

The decision making process for trajectory planning of an autonomous vehicle implies to know at all times the position of the obstacles in the near environment. When the obstacles are moving (other vehicles, pedestrians), it is also necessary to predict their future trajectories, to prevent any risk of collision with the planned trajectory of the ego-vehicle. In the case of a vehicle driven by a human or a pedestrian, it is impossible to fully predict their ongoing maneuvers. In order to predict the likely trajectories of the obstacles, it is necessary to set up algorithms for predicting the intentions of other users.
The first step consists of an estimation of the obstacles' current dynamics, by relying on the previous localization data resulting from perception algorithms. Then, based on the obstacles' past trajectories and their current dynamics, future trajectories will be generated. For this, two approaches coexist according to the time horizon targeted: In the short term, future positions can be extrapolated from a dynamic evolution model. For this, we assume that the dynamics of the target remains constant. This approach will therefore only be valid for a limited time horizon (of the order of one second). In the longer term, to obtain a prediction of the trajectory over several seconds, it is necessary to estimate the ongoing target vehicle's manoeuver.
This presentation will focus on the maneuver prediction of vehicles on multi-lane highways, typically lane changes and overtaking manoeuvers. Different approaches to address this issue will be presented, like the Bayesian regression based on multiple probabilistic trajectory models, or by mean of machine learning classification algorithms. The presented methods, relying on the fusion of proprioceptive sensors and obstacle detection sensors, like lidars or radars, are compatible with classic autonomous vehicle architectures

Title : "AUTONOMOUS MOBILITY AND THE TRANSFORMATIONS OF URBAN AND TERRITORIAL SPACE"
Speaker : Ander GORTAZAR, PhD student, RAZ Co-founder & Researcher collaborator
Affiliation : Polytechnic University of Catalonia

Abstract

Autonomous mobility is a socio-political concept, previous in time and hierarchy to the technological advance that the autonomous vehicle (AV) represents. The report presents, on one hand, the irruption of the AV in a context of technological disruption where the AV is, simultaneously, cause and consequence; on the other hand, it explores the possible transformations of the urban and territorial space derived from it. The hypothesis is based on the assumption that the direction of these transformations will be determined by the capacity of the AV to force a change of paradigm in different areas, where two debates stand out: the debates on property and efficiency.
The concept of ownership is probably the most important paradigm that the autonomous vehicle can transform. Will we own an AV or will we simply use it? Although a large part of the experts assume that the AV will involve a paradigm shift (the vehicle understood as an asset that is used, not an asset that is owned), this shift is not clear at all as it would substantially affect the sales of car manufacturers. And since the problem of mobility is mainly geometric, the AV in ownership would not solve the problem of congestion by itself, nor the need for parking.
Experts agree that the AV would lead to an improvement in efficiency, especially spatial: more fluid traffic, minimization of surface parking, etc. Opinions diverge, however, when estimating what impact this improvement in efficiency would have. On one hand, logic suggests that the need for space decreases with equal demand. On the other hand, Jevons paradox states that when technological advancement improves the efficiency with which a resource is used, an increase in the consumption of this resource is more likely than a decrease.
Beyond the debate on property and efficiency, the AV will transform the public space at different scales. The report analyses different visions from different sources (car manufacturers, architects and town planners, large consulting firms, cities and public transport companies, start-ups and other service providers and popular culture), and attempts to explain them by organizing them through architectural, urban and territorial elements from smaller to larger scale: the parking lot, the street, the intersection, the city, the highway and the territory.