Governing Automated Vehicle Behavior

Mots clés :
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- Co-encadrant(s) :
- Unité de recherche : Institut des Systèmes Intelligents et de Robotique
- École doctorale : Ecole Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal : Divers

Résumé du projet de recherche (Langue 1)

The objective of this thesis proposal is to conduct research in Robotics and Artificial Intelligence to design and validate a decision-making system for an automated vehicle that is also equipped with real-time perception and motion control. Given the difficulty to fully predict the behavior of dynamic objects in traffic environment, there could be situations where collisions might become inevitable. The aim of the decision-making system would be to minimize risk and damage (Goodall, 2014). A risk that cannot be avoided can be at best redistributed, and thus, the decision turns into an ethical issue: there will no “good” solution and the decision will involve a trade-off between the interests of different parties involved. An AV does not have a sense of ethics. Nonetheless, it would have to make real time decisions of risk distribution in ethical dilemmas involving high uncertainty. There are several moral theories that try to explain or to guide human decisions (deontic, utilitarian, casuistic, …) that could be applied as such to machine decisions. One of the first tasks of the candidate will be to study moral theories and to become acquainted with their philosophical foundations. Simultaneously, literature on machine ethics will be also studied (Allen 2006, Chauvier 2014), specifically in the context of autonomous vehicles (Lin 2015, Bonnefon 2015). The candidate will develop and implement an artificial moral agent based on different moral theories. This decision-making system will have to cope with evolving conditions and take into account perception and action uncertainties. Research will therefore explore and implement uncertain representations, e.g., Bayesian representations and Bayesian networks (Ferreira 2013) and decision-making approaches, e.g., Markov processes or game theory, in the context of multi-agent systems, in which each agent have partial information, non-identical and maybe conflicting goals and interests. This is a major objective of the thesis. The work will also include the development of a simulation environment to study scenarios and situations for characterizing different ethical approaches, and enabling to study human reactions as well. Furthermore, the work will investigate how the system could be able to adapt its behavior by learning from user decisions, instead of merely applying its own policy. The simulation environment will have to embed this capacity. Research will be performed to propose an appropriate learning approach from acquired data on the situation and driver decisions. This will also enable to provide a comparative study on human and artificial ethics.

Résumé du projet de recherche (Langue 2)

Automated vehicles (AVs) will soon share roads and streets with other users and vehicles – automated or not – and in crowded urban environment, with pedestrians, cyclists and other mobile objects. The AV decision-making system will have to cope not only with actual traffic conditions, abide by traffic rules, stop on traffic lights, yield to traffic with higher priority, etc. but also to avoid obstacles and correctly react in unusual and unpredicted situations, such as pedestrians suddenly crossing the street or other vehicles' abnormal motions. It is therefore of prime importance that the AVs is equipped with a decision-making system that enables it to manage its driving at all times and in all situations.

Informations complémentaires (Langue 1)

This thesis proposal is in the framework of the ANR AVEthics project, “Ethics policy for automated vehicle”, granted to VEDEC0M Institute, the Institute of Intelligent Systems and Robotics (ISIR) at University Pierre and Marie Curie, and University Paris-Sorbonne. VeDeCoM is a French “Institute for energy transition”. It is supported by the Mov'eo competitiveness cluster, and by community organisations. It's located in Versailles, South West of Paris. The aim of VeDeCoM is to foster research and innovation on pre-competitive and pre-normative topics in a public-private partnership along three domains : 1) new electric vehicle powertrains, 2) driving delegation, and autonomous and connected vehicles, 3) shared mobility and energy based on new usages and innovative infrastructures and services. VeDeCoM involves more than 40 industrial and academic members. Its staff gathers scientist and engineers in physics and chemistry, mechanical and electrical engineering, information and communication, telecommunication, psychology, sociology and economy to explore new use cases. Vedecom, directly or through its founding partners such as Renault, PSA or Valeo has multiple international interactions. ISIR is a large robotics and AI lab at UPMC with a wide international cooperation network and is part of several European projects.

Informations complémentaires (Langue 2)
Sought profile:
- Master in Computer Science or Electrical Engineering.
- Background in Robotics, Perception, Probabilistic and Bayesian reasoning.
- Strong programming skills (C, C++, other).
- Experience in serious games and simulation environments if possible.
- Languages: English, French

Useful references: