SOUTENANCE DE THÈSE

Monsieur Édouard Capellier

Soutiendra sa thèse de **doctorat** sur le sujet **:**

Application of machine learning techniques for evidential 3D perception, in the context of autonomous driving

Unité de recherche : **HEUDIASYC – UMR CNRS 7253**

Le mardi 14 janvier 2020 à 14h
A l'UTC, salle GI42 du bâtiment Blaise Pascal

Devant le jury composé de :

M. Frédéric Pichon, maître de conférences HDR, université d'Artois, Béthune, rapporteur

M. François Goulette, professeur, Mines Paris Tech, Paris, rapporteur

M^{me} Samia Ainouz, maître de conférences HDR, INSA, Rouen, membre

M. Thierry Denoeux, professeur des universités, université de technologie de Compiègne, laboratoire Heudiasyc, président

M^{me} Véronique Cherfaoui, professeur des universités, université de technologie de Compiègne, laboratoire Heudiasyc, directeur de thèse

M. Franck Davoine, chargé de recherches CNRS HDR, université de technologie de Compiègne, laboratoire Heudiasyc, directeur de thèse

Membre invité :

M. You Li, ingénieur de recherche, Renault SAS, Guyancourt

Abstract

The perception task is paramount for self-driving vehicles. Being able to extract accurate and significant information from sensor inputs is mandatory, so as to ensure a safe operation. The recent pevolutions of machine-learning techniques revolutionize the way perception modules, for autonomous driving, are being developed and evaluated, while allowing to vastly overpass previous state-of-the-art results in practically all the perception-related tasks. Therefore, defining efficient and accurate ways to model the knowledge, that is used by a self-driving vehicle, is mandatory. Indeed, self-awareness, and appropriate modeling of the doubts, are desirable properties for such system. In this work, we assumed that the evidence theory was an efficient way to finely model the information extracted from deep neural networks. Based on those intuitions, we developed three perception modules that rely on machine learning, and the evidence theory. Those modules were tested on real-life data. First, we proposed an asynchronous evidential occupancy grid mapping algorithm, that fused semantic segmentation results obtained from RGB images, and LIDAR scans. Its asynchronous nature makes it particularly efficient to handle sensor failures. The semantic information is used to define decay rates at the cell level, and handle potentially moving object. Then, we proposed an evidential classifier of LIDAR objects. This system is trained to distinguish between vehicles and vulnerable road users, that are detected via a clustering algorithm. The classifier can be reinterpreted as performing a fusion of simple evidential mass functions. Moreover, a simple statistical filtering scheme can be used to filter outputs of the classifier that are incoherent with regards to the training set, so as to allow the classifier to work in open world, and reject other types of objects. Finally, we investigated the possibility to perform road detection in LIDAR scans, from deep neural networks. We proposed two architectures that are inspired by recent state-of-the-art LIDAR processing systems. A training dataset was acquired and labeled in a semi-automatic fashion from road maps. A set of fused neural networks reaches satisfactory results, which allowed us to use them in an evidential road mapping and object detection algorithm, that manages to run at 10 Hz.