Thesis subject: **Distributed and augmented vehicle perception to support autonomous driving**

PhD Advisors:

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Context of the thesis:

The candidate will join an ambitious project that will open doors to a career in international science. He or she will be based in the Heudiasyc laboratory in Compiègne (located along the Oise river, 45 minutes by train from central Paris). Heudiasyc is a joint lab with CNRS – the national center for scientific research – and the Université de Technologie de Compiègne. In 2011, it was rated A+ (the highest rate) by the French national research evaluation agency. Heudiasyc fosters interdisciplinary research on information science and technology including machine learning, uncertain reasoning, operations research, robotics and knowledge management. In 2011, Heudiasyc was awarded with a project of excellence on the «Control of Technological Systems of Systems» (Labex MS2T, www.labexms2t.fr), funded by the "Investment for the future" national program. The laboratory has strong relations with the automotive industry and advanced international research teams in intelligent vehicles. The PhD project will include collaborations with international academic partners and with carmakers.

The studentship is funded for 3 years by the Labex (currently 1700€ per month -- gross salary). Affordable housing is easy to find in Compiegne.

PhD thesis description:

Today, driver assistance systems have entered the market, with successes like adaptive cruise control and lane keeping assistance. Despite this, much research and development efforts are still necessary to go toward autonomous driving with complex tasks to perform (e.g. overtaking and lane changing on motorways, or crossing intersections in urban areas). The development of these systems relies on multi-sensory perception functions, communication, information processing, automatic and adaptive learning.

Vehicles so-called “smart” or “intelligent” have variable capabilities in terms of self-localization, perception of the driving environment or even prediction of trajectories of other traffic participants. They can take advantage of perceptual or intentional information exchanged with other road users (e.g. vehicles, pedestrians or bicycles) to augment their field of view and situational awareness of the dynamic traffic scene. Furthermore, vehicles can exploit information provided by roadside units, by the infrastructure, or high-level context given by digital maps.

The goal of this PhD thesis is to improve the performance of perception algorithms. The research will build on our previous works on multimodal information fusion for driving scene labeling and object detection [1,2,3]. In a first phase, new solutions based on deep learning architectures will be investigated, to improve the detection of “difficult objects” in the scene (small, blurred, occluded). In a second phase, the candidate will work on the definition of useful information that, when exchanged with other traffic participants or with the infrastructure, will help to augment the perception of the vehicle. Uncertainties about these descriptors must be estimated (e.g. uncertainty about the class of moving objects detected in scene, their position, their trajectory in the 3D scene, etc.). Such information will be represented in a common frame, and combined with the information extracted in a standalone way from on-board sensors.

Tests and evaluations will be done through different scenarios (e.g. crossroads, overtaking or roundabout), in close collaboration with Heudiasyc researchers working in the field of machine learning, driving scene perception, uncertainty modeling and distributed information fusion in vehicular ad hoc networks. Furthermore, the developed perception methods will be evaluated using public datasets, and on data acquired with Heudiasyc lab's experimental vehicles.

Keywords: Multimodal perception, computer vision, scene labeling, deep learning, distributed information fusion, uncertainties.

[1] Ph. Xu, F. Davoine, J.-B. Bordes, H. Zhao, T. Denœux, Multimodal Information Fusion for Urban Scene Understanding, Machine Vision and Applications, To appear, 2015.

[2] Ph. Xu, F. Davoine, and T. Denœux, Evidential combination of pedestrian detectors, BMVC - British Machine Vision Conference, Nottingham, UK, Sept. 1-5, 2014.

[3] Ph. Xu, F. Davoine, and T. Denœux, Evidential Logistic Regression for Binary SVM Classifier Calibration, Belief - Third International Conference on Belief Functions, Oxford, UK, Sept. 26-28, 2014.

Dates: position open from September to December 2015 (earlier or later start dates can be negotiable).

Candidate's profile:

- Master degree (preferably in Computer Science or Applied Mathematics).
- Solid programming skills; the project involves programming in C, C++, Matlab, Python…
- Solid mathematics knowledge (especially linear algebra and statistics).
- Creative and highly motivated.
- Fluent in English, both written and spoken;
- Prior knowledge in the areas of computer vision or machine learning is a plus.

Documents required to apply:

Send to: franck.davoine@hds.utc.fr (best as a single PDF file!):

- Detailed Curriculum vitae
- Master graduation marks as well as ranks
- Motivation letter for the PhD project
- Name and email addresses of two references

(Eligible candidates will be invited for a SKYPE interview).

Location:

Laboratory Heudiasyc UMR CNRS 7253
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