## 2020-02884 - PhD Position F/M Validation of IA-based perception components in autonomous vehicles

<table>
<thead>
<tr>
<th>Type de contrat :</th>
<th>CDD</th>
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<tr>
<td>Niveau de diplôme exigé :</td>
<td>Bac + 5 ou équivalent</td>
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<tr>
<td>Autre diplôme apprécié :</td>
<td>Master recherche ou équivalent</td>
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<td>Fonction :</td>
<td>Doctorant</td>
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<tr>
<td>Niveau d'expérience souhaité :</td>
<td>Jeune diplômé</td>
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### A propos du centre de la direction fonctionnelle

**Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 39 research teams and 8 research support departments.**

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

### Contexte et atouts du poste

The PhD thesis will be done in a 3-year collaborative R&D project involving academic and industrial partners. It will be co-supervised by the Chroma and Convecs project-teams of the Inria Grenoble – Rhône-Alpes Centre.

The overall objective of Chroma is to address fundamental and open issues that lie at the intersection of “Human-Centered Robotics” and “Multi-Robot Systems”. Our goal is to design and develop models allowing mobile robots to navigate and interact in dynamic and human-populated environments. Chroma is involved in all decision aspects pertaining to robot navigation tasks, including perception and motion-planning. Our approach for addressing this challenge is to bring together probabilistic methods, planning techniques and multi-agent decision models. The Autonomous Vehicles research represents an important part of this work and it involves several academic and industrial projects, including collaborations with companies such as Renault or Toyota.

The activities of CONVECS focus on the formal modeling and verification of asynchronous concurrent systems, which are instantiated in various domains (communication protocols, distributed algorithms, embedded systems, etc.). To this aim, CONVECS proposes new formal languages for specifying the behaviour and the properties of concurrent systems, and devises efficient verification algorithms and tools running on sequential and massively parallel machines. The research results of CONVECS are instantiated in the CADP verification toolbox ([http://cadp.inria.fr](http://cadp.inria.fr)), which is widely used in academia and industry.

### Mission confiée

**Objective:** Assessment of the safety and security of autonomous vehicles and definition of the principles of the validation process for their components, with a particular attention to algorithms based on artificial intelligence.

The rapid development of Artificial Intelligence (AI) and its vast diffusion in all sectors of activity, raise specific questions in terms of guarantees on their proper functioning. In particular, automotive systems, where both perception and decision-making algorithms rely on probabilistic AI-based approaches, require a thorough validation of all their components before being used in everyday life. However, guaranteeing safety and reliability poses a significant challenge due to the complexity of these solutions and the inevitable uncertainties on the road.

The expected work will exploit and improve a perception algorithm developed in the Chroma team, the CMCDOT. This grid-based approach is a Bayesian...
filtering system for environment representation through dynamic occupation grids, allowing parallel estimation of occupation probabilities for each cell, inference of velocities and prediction of the risk of collision. New solutions to add semantic information based on deep learning techniques will be also considered and analyzed. An important part of the thesis will be then dedicated to formally validate the obtained results through tests on a realistic autonomous driving simulator (e.g., Carla) and real experiments conducted with our fully autonomous car (Renault Zoe).


Principales activités
Main activities:
- Definition of criteria for the evaluation of dynamic occupation grids and semantic maps.
- Proposal of a formal validation methodology for Bayesian perception and prediction methods.
- Study of behavioral modeling of the simulated vehicle environment (e.g., dynamic, static obstacles, road configuration, etc.) for the automatic generation of relevant, borderline case scenarios.
- Formal modeling of the critical subsystems and verification of their functional properties (e.g., absence of deadlocks, detection and correct prediction of collisions, etc.).
- Definition and development of a hybrid simulation function with injection of real data and integration into a formal validation model for co-simulation.
- Generation of conformance test cases in controlled environments from a formal model of the environment and the system for the evaluation of KPIs. Study of the coverage of relevant tests against the formal model.

Compétences
The candidate will have a Master 2 level or equivalent, in computer science, AI or robotics.
Technical skills: experience with ROS and C++; knowledge of formal methods for concurrent systems and deep learning techniques is a plus.
Languages: proficiency in English; knowledge of French also welcome.
Relational skills: team working.

Avantages
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération
1st and 2nd year: 1 982 euros brut/month
3rd year: 2,085 euros brut / month