

## Sujet de stage au laboratoire Heudiasyc UMR 7253

Titre/Title	<b>Collaborative map update using Lidar for autonomous vehicles localization</b>
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Descriptif du sujet/ Project description	<p>The context of this internship is the navigation of autonomous vehicles that can perceive their environment and interpret it without any human intervention. These vehicles must be located with an accuracy suitable for the navigation task and with a high level of confidence called integrity. In this internship, we consider a buildings map represented by planar surfaces constructed from OpenStreetMap. This map is used to perform localization in urban environments where GNSS signals are affected by strong errors [1] [2].</p> <p>Maps require continuous updates as changes are frequent and can lead to localization problems [3]. The goal of this internship is to perform map updates by adding missing elements to the map (with regard to buildings). The problem of removing a building that no longer exists is not part of the topic.</p> <p>This map is associated with the measurements of a 3D Lidar located on the roof of the vehicle. The observations from the Lidar, which are not matched to the current map, should be considered in the updated map. One of our goal is to profit from the collaboration between several vehicles to perform this step and to increase the number of vehicles that detect the changes.</p> <p>The approach will include the following steps:</p> <ul style="list-style-type: none"> <li>- Detection of new features classified as buildings to be added to the map through vehicles collaboration. This step will require a good localization of the vehicles. Missing elements will be added to the map when confidence in their existence and position is high enough.</li> <li>- Detailed characterization of the facade buildings through Normal Distributions modeling [4].</li> </ul> <p>The choice of the method will be done after a state of the art on map update in the field of robotics and intelligent vehicles.</p> <p>Zoé automated vehicles equipped with Lidar, GNSS and wheel speed sensors will be used for the validation of the approach. The development will be done in ROS using Python and C++.</p> <p>This internship will be based on the work of a PhD researcher where some codes have already been developed.</p>

	<p>[1] Maxime Escourrou, Joelle Al Hage, Philippe Bonnifait, Decentralized Collaborative Localization with Map Update using Schmidt-Kalman Filter, 2022 25th International Conference on Information Fusion (FUSION), Jul 2022, Linköping, Sweden. pp.1-8.</p> <p>[2] Maxime Escourrou, Joelle Al Hage, Philippe Bonnifait, NDT Localization with 2D Vector Maps and Filtered LiDAR Scans, 10th European Conference on Mobile Robots (ECMR 2021), Aug 2021, Bonn (on line), Germany. pp.1-6.</p> <p>[3] Berrio, Julie Stephany, et al. "Long-term map maintenance pipeline for autonomous vehicles." IEEE Transactions on Intelligent Transportation Systems (2021).</p> <p>[4] Javanmardi, Ehsan, et al. "Autonomous vehicle self-localization based on abstract map and multi-channel LiDAR in urban area." IATSS research 43.1 (2019): 1-13.</p>
Pré-requis	Master in robotics/computer science, good coding skills, rigor
Possibilité de poursuite en thèse/ Possibility of continuing in PhD	Yes