Improvement of lidar detection and tracking algorithm using and development of a multi-sensor fusion module. Implementation in the PROSIVIC simulation platform

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Ensuring the reliability of the perception of an intelligent vehicle is recognized as one of the challenges for the transition to the higher levels of autonomous driving. From a technological perspective, safety is enforced using combinations of sensors systems exploiting different physics principles used by optical sensor such as camera [1], by near infrared sensors like laser scanner [2], electromagnetic sensors like RADAR [3] and radiofrequency and ultrasonic sensors. Each sensing system is defined by its own hardware components, electronics and detection function with embedded processing which deliver a variable performance according the driving environment characteristics. Validating of perception functions for autonomous driving– and of the sub-functions involving the detection, tracking, object recognition– is extremely complex by the extent and the variety of the conditions to be tested (sensor, infrastructure, object, weather, … features). Gradually, the industry has embraced the idea of introducing simulation methods to support such validation [4, 5]. This study aims to improve a targets detection and tracking algorithm by laser scanner. These improvements relate to the targets detection and tracking modules in which new functionalities have been implemented to improve algorithm results. A code optimization has been implemented to improve the execution time of the algorithm and thereby increase the performance of data processing. The algorithm was tested with real data of SICK LIDAR, and synthetic LIDAR data with 4 and 16 layers simulated by PROSIVIC platform. The use of simulation helps us to study the influence of several parameters on the detection like effects of impacts points number, weather condition and to test the algorithm robustness. In addition, a study of the libraries was carried out in order to know the dependencies of the algorithm for the power to integrate at best in the PROSIVIC simulation platform. This report thus made it possible to show how these improvements were implemented in order to achieve the objectives as well as the functioning of these improvements.

References:

[1] GRUYER, Dominique, GRAPINET, Mélanie, et DE SOUZA, Philippe. Modeling and validation of a new generic virtual optical sensor for ADAS prototyping. In : *2012 IEEE Intelligent Vehicles Symposium*. IEEE, 2012. p. 969-974.
[2] Hadj-Bachir, M.; Souza, P. LIDAR Sensor Simulation in Adverse Weather Condition for Driving Assistance
Development; hal-01998668; Hyper Articles en Ligne (HAL): Lyon, France, 2019.

[3] Jean-Claude Kedzia, Philippe de Souza, and Dominique Gruyer, « Advanced RADAR Sensors Modeling for Driving Assistance Systems Testing.", in proceeding of EuCAP 2016, Davos, 10-15 April 2016, Switzerland

[4] D. Gruyer, S. Choi, C. Boussard, B. d'Andrea Novel , « From Virtual to Reality, How to Prototype, Test and Evaluate New ADAS: Application to Automatic Car Parking.", Accepted in IEEE Intelligent Vehicles symposium (IV2014), Dearborn, Michigan, June 8 – 11, 2014, USA.

[5] HADJ-BACHIR, Mokrane, DE SOUZA, Philippe, et GRUYER, Dominique. Virtuelle Tests autonomer Funktionen durch Simulation. *ATZextra*, 2020, vol. 25, no 1, p. 18-21.

[6] Dominique Gruyer, Mohamed Rahal, « Multi-Layer Laser Scanner Strategy for Obstacle Detection and Tracking." in AICCSA (ACS/IEEE International Conference on Computer Systems and Applications) 2019, Abu Dhabi, UAE, Nov 03 – Nov 07, 2019.

[7] Dominique Gruyer, Valentin Magnier, Mohamed Rahal, Guillaume Bresson, "Real-Time Architecture For Obstacle Detection, Tracking And Filtering: An Issue For The Autonomous Driving", in Journal of Intelligent Computing (DLINE Journal portal), Volume 8, Number 2, June 2017. Print ISSN: 0976-9005, Online ISSN: 0976-9013. http://www.dline.info/jic/v8n2.php

[8] Dominique Gruyer, Sébastien Demmel, Vincent Magnier, Rachid Belaroussi, «Multi-Hypotheses Tracking using the Dempster–Shafer Theory, application to ambiguous road context.», in Information Fusion, Elsevier, Volume 29, May 2016, Pages 40-56. DOI: 10.1016/j.inffus.2015.10.001.