

Grades of Operational and Tactical Automation in rail domain for an Artificial Intelligence Driving Assistance System

Jean-Valentin Merlevede¹, Simon Enjalbert¹, Frédéric Vanderhaegen^{1,2}

¹ Univ. Polytechnique Hauts-de-France, CNRS, UMR 8201 - LAMIH, F-59313, Valenciennes, France

² INSA Hauts-de-France, F-59313 Valenciennes, France

(jeanvalentin.merlevede, simon.enjalbert, frederic.vanderhaegen)@uphf.fr

The work presented in this paper is conducted as part of the Academics4Rail Project, funded by Europe's Rail, the new European partnership in the railway sector within the framework of the Horizon Europe research project. The aim of Academics4Rail is to propose driver assistance systems for railway driving. In the first section, we will be looking at degrees of automation, in order to propose additional levels of progressive driver assistance. This work proposes new additional levels of progressive driver assistance, extending the traditional Grades Of Automation (GoA) in order to allow both dedicated Operational and Tactical assistances. The second contribution is an Artificial Intelligence Driving Assistance System (AIDAS) that aims to reintegrate the driver into the train driving activity with the new Grades of Operational and Tactical Automation (GOTA) defined previously, taking into account human involvement and driving skills. The framework of Digital Co-Driver (DCD) is comprised of multiple monitoring and modules, each addressing a distinct issue arising from the augmented level of automation. The Driver State, Driving Performance and Environmental Monitoring provide indicators of global driver involvement to maintain a high level of performance in manual driving and to deal with system failures. The GOTA Selector Module then helps the driver to be optimally engaged while driving by adapting the GOTA to the specific needs. Finally, the Driver Companion Module learns about the driver's preferences and needs to adapt the assistance and help the driver to improve their own driving skills.

Références

- [1] L. Habib, O. Oukacha, et S. Enjalbert, « Towards Tramway Safety by Managing Advanced Driver Assistance Systems depending on Grades of Automation », IFAC-PapersOnLine, vol. 54, no 2, p. 227-232, 2021, doi : 10.1016/j.ifacol.2021.06.027.
- [2] M. Vagia, A. A. Transeth, et S. A. Fjerdigen, « A literature review on the levels of automation during the years. What are the different taxonomies that have been proposed? », Applied Ergonomics, vol. 53, p. 190-202, mars 2016, doi : 10.1016/j.apergo.2015.09.013.
- [3] J.-V. Merlevede, S. Enjalbert, F. Henon, A. P. Baños, S. Ricci, et F. Vanderhaegen, «Expectations of train drivers for innovative driving cabin », IFAC-PapersOnLine, vol. 55, no 29, p. 144-149, 2022, doi : 10.1016/j.ifacol.2022.10.246.
- [4] N. Besinovic et al., « Artificial Intelligence in Railway Transport: Taxonomy, Regulations, and Applications », IEEE Trans. Intell. Transport. Syst., vol. 23, no 9, p. 14011-14024, sept. 2022, doi : 10.1109/TITS.2021.3131637.
- [5] R. Tang et al., « A literature review of Artificial Intelligence applications in railway systems », Transportation Research Part C : Emerging Technologies, vol. 140, p. 103679, juill. 2022, doi : 10.1016/j.trc.2022.103679.
- [6] J. Huang, Y. Cai, J. Li, X. Chen, et J. Fan, « Toward Intelligent Train Driving through Learning Human Experience », in 2019 1st International Conference on Industrial Artificial Intelligence (IAI), Shenyang, China : IEEE, juill. 2019, p. 1-6.
doi: 10.1109/ICIAI.2019.8850749.