

Post-doctoral position – 12 months extendable to 18 months



Title: Safety assurance of autonomous trains.

Location: Univ-Eiffel – Lille Campus – ESTAS laboratory, France

Host laboratory

Université Gustave Eiffel (UGE) is a French multidisciplinary university of national importance. Since the 1st of January 2020 this new institution has brought together a university (UPEM), a research institute (IFSTTAR), a school of architecture (EAV&T) and three engineering schools (EIVP, ENSG and ESIEE Paris). The ESTAS laboratory (Evaluation and Safety of Automated Transport Systems) develops methods, techniques and tools intended to help analysing the safety of guided transport systems. The finalized research, which is one of the main features of ESTAS, finds its foundations in the synergy between applied research and feedback from expertise and technical assistance activities in the field of guided transport systems.

Details

Context

This position is part of the "Safety Assessment of Railway Systems" axis of the "Safety of Railway Systems" Chair. The latter is supported by CERTIFER Association and GAPAVE, a grouping that includes several actors in the railway field: operators, manufacturers and independent safety assessors.

The research work that will be carried out within the framework of this position aims to contribute to the challenge of fully autonomous vehicles in the railway domains. The introduction of autonomy to railway requires a review of the previously established safety principles and processes. The main objective of autonomous train is to perform its operations with an acceptable safety level in all possible operational conditions.

Work description

The case of autonomous train raises a fundamental issue regarding its definition, concept and integration with the railway system; particularly due to the withdrawal of the human operators from the train control loop. The main objective of autonomous train is to perform all its mission in all operation conditions without impacting or regressing the overall safety level of the railway system. Such an objective shall be achieved by assuring that all the hazards have been identified, assessed and controlled or reduced to an acceptable level.

The proposed work aims at analysing the state of the arts related to:

- The development of autonomous train projects and associated Operational Design Domain (ODD).
- The approaches used in the existing projects to ensure that the AI-based component satisfies the safety levels in its defined ODD.
- Review, from a safety point of view, of the cross-acceptance of existing products in use in other critical domains.

Expected outcomes of this literature review include the writing of a deliverable for the related state of the arts and proposing an approach for safety assurance of autonomous train with the support of CERTIFER's experts. They include journal publications and conference communications on these topics of autonomous trains, cross-acceptance, and formal methods for the safety of AI.

References:

- Alexander, R., Asgari, H., Ashmore, R., Banks, A., Bongirwar, R., Bradshaw, B., Bragg, J., Clegg, J., Fenn, J., Harper, C., et al., 2020. Safety assurance objectives for autonomous systems. Safety Critical Systems Club (SCSC) .
- Mohammed Chelouati, Abderraouf Boussif, Julie Beugin, El Miloudi El Koursi "Graphical safety assurance case - Challenges, opportunities and a framework for Autonomous trains », Reliability Engineering and System Safety, 2022

- Chelouati, M., Boussif, A., Beugin, J., El Koursi, E.M., 2022. A framework for risk-awareness and dynamic risk assessment for autonomous trains, in: ESREL 2022, 32nd European Safety and Reliability Conference, pp. 1–8.
- Mohammed Chelouati, Abderraouf Boussif, Julie Beugin, El Miloudi El Koursi “Graphical safety argumentation for safety assurance of autonomous trains”, Congrès Lambda Mu 23 : Innovations et maîtrise des risques pour un avenir durable, du 10 au 13 octobre 2022 à EDF Lab - Paris Saclay.
- Mohammed Chelouati, Abderraouf Boussif, Julie Beugin and El Miloudi El Koursi “A framework for risk-awareness and dynamic risk assessment for autonomous trains”, 32nd European Safety and Reliability Conference (ESREL) - Dublin 2022.
- Abhimanyu Tonk, Mohammed Chelouati, Abderraouf Boussif, Julie Beugin and El Miloudi El Koursi “A safety assurance methodology for autonomous trains” 9th Transport Research Arena TRA Lisbon 2022, Portugal.
- Khastgir, S., Brewerton, S., Thomas, J., Jennings, P., 2021. Systems approach to creating test scenarios for automated driving systems. Reliability Engineering & System Safety 215, 107610.
- Tonk, A., Boussif, A., 2022. Operational Design Domain or Operational Envelope: Seeking a suitable concept for autonomous railway systems, in: ESREL 2022, In 32nd European Safety and Reliability Conference, pp. 1–8.
- Tonk, A., Boussif, A., Beugin, J., Collart-Dutilleul, S., 2021. Towards a specified operational design domain for a safe remote driving of trains, in: 31st European Safety and Reliability Conference ESREL 2021, p. 8.
- Pierre-Jean Meyer, Reachability analysis of neural networks using mixed monotonicity. IEEE Control Systems Letters, v. 6, p. 3068-3073, 2022.
- Liu, C., Arnon, T., Lazarus, C., Strong, C., Barrett, C., & Kochenderfer, M. J. (2021). Algorithms for verifying deep neural networks. *Foundations and Trends® in Optimization*, 4(3-4), 244-404.

Candidate profile:

- PhD or equivalent. degree in automation engineering, computer science or applied mathematics
- Knowledge in dependability and safety, system analysis and formal modelling
- Ability to synthesise, capacity for self-training, sense of initiative, rigour, pedagogy
- Excellent writing skills, proficient in French or in English (spoken and written)

Information:

- The application (resume, cover letter, and reference letter(s)) has to be addressed by e-mail to: el-miloudi.el-koursi@univ-eiffel.fr and pierre-jean.meyer@univ-eiffel.fr
- Type of contract: fixed-term contract of 12 months extendable to 18 months
- Gross salary: ~2 500 € / months.