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| RAILENIUM TEST & RESEARCH CENTRE | **VACANCY**<br>**Réf.: VN 2019/01** |

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| **Title** | **POST-DOCTORAL RESEARCHER FOR SAFETY ANALYSIS**<br>Performance and Safety Analysis of Train-to-Train communications |

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| **Department:** | Autonomous Train | **Type of contract:** | Fixed-term contract 18 months |
| **Direct supervisor:**<br>**Scientific supervisors:** | Émilie Masson<br>Marion Berbineau (Ifsttar), Mohamed Ghazel (Ifsttar) | **Status:** | Executive |
| **Localisation:** | Railenium (Villeneuve d'Ascq or Valenciennes) | **Annual gross salary:** | ~35 k€ |
| **Starting date:** | 01/02/2019 | | |

## Context

As a test and applied research centre for the railway sector, the IRT Railenium (http://railenium.eu/fr/) aims to develop, through collaborative innovation, the competitiveness of companies as engines of growth and employment.
Railenium implements innovation partnerships between manufacturers (in the broad sense: infrastructure managers, operators, builders and engineers) and academia to ensure a high-level response to the challenges of the railway sector. Based in the Hauts-de-France region, supported by the State and the railway sector, and acting in synergy with the i-Trans competitiveness cluster on land transport, the IRT is backed by a network of excellence of research centres and laboratories.
The X2Rail-3 project is a European project in the framework of the Shift2rail program (www.shift2rail.eu). It aims to research and develop selected key technologies to foster innovations in the field of railway signalling and automation systems towards a flexible, real-time, intelligent traffic management and decision support system. This 18 months post-doctoral research position is offered in the context of the X2RAIL-3 European project. The position will be held by Railenium for a work with Ifsttar/Cosys/Leost laboratory and Railenium.

## Missions

Performance and Safety Analysis of Train to Train communications in the context of virtual coupling of trains.

Virtual coupling between two trains is under development. The system will be based on the use of wireless communications between the two vehicles (V2V). Consequently, the safety of the wireless link should be analysed. Several wireless communications systems are studied to answer the need of virtual coupling of two trains. No choice has been yet decided. The technology assessment will be performed within the Shift2rail program.
Several technologies are considered: ITS-G5 coming from automotive world, 60 GHz link based on 5G technology and LTE-A system (Long Term Evolution-Advanced) which is also consider for other railways applications, particularly Train-to-Ground links. Whatever will be the chosen system to answer the virtual coupling needs, the failures of the wireless link jeopardize the safety level. Thus, it is essential to guarantee a level of trust for the communication system that achieves this wireless link. This guarantee is expressed by the railway safety standards (EN 50126, 50129, 50159) according to the operating safety parameters FDMS (Reliability, Availability, Maintainability, Safety). The dependability analysis then seeks to identify and characterize all sources of errors or failures degrading the wireless communication link in order to evaluate, in view of these disturbances, the quality and the risk associated with the transmission system.
Based on the safe virtual coupling application definition, the aim of the postdoctoral position is first to characterize the service interruption due to communication errors and to define the critical events. More precisely, occurrence probabilities of single errors will be first analysed. Then, we will look for probabilistic analytical expressions of several temporal conditions that lead to critical events. In parallel we will follow a simulation approach using Petri net models in order to check the results of the analytical approach [1]. We would like to follow the methodology proposed by [2] in another context. The main difficulty of this research lies in the estimation of the degradation suffered by the radio signals, the impact of the traffic load of the system and in particular the impact of the choices concerning the system architecture.

**[1]** M. A. Marsan, G. Balbo, G. Conte, S. Donatelli and G. Franceschinis, "Modelling with generalized stochastic Petri nets" in John Wiley & Sons, Inc., 1994.
**[2]** K. T. P. Nguyen, J. Beugin, M. Berbineau and M. Kassab, "A New Analytical Approach to Evaluate the Critical-Event Probability Due to Wireless Communication Errors in Train Control Systems," in IEEE Transactions on Intelligent Transportation Systems, vol. 18, no. 6, pp. 1380-1392, June 2017.

## Competence

| Skills | Know-how |
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| PhD degree in computer science and automatic, safety assessment, Petri Nets, formal methods, fluent English, experience in writing journal papers, knowledge of Railway domain will be a plus. | Autonomy, dynamism and reactivity, sense of initiative, Excellent relationship, rigor, teamwork with industry, taste for hardware implementation. Travels in Europe are expected |

Candidatures (cover letter + detailed CV + referees) should be sent by email with reference VN 2019/01, to recrutement@railenium.eu.