

**Title**

**POSTDOCTORAL RESEARCHER – SAFETY ASSESSMENT METHOD FOR A SAFE AND CERTIFIED GNSS LOCALISATION IN THE RAILWAY DOMAIN**  
**X2RAIL-2 / WP3 PROJECT**

<b>Department:</b>	Direction Innovation R&D	<b>Type of contract:</b>	Fixed-term contract 12 months
<b>Managers:</b>	Émilie MASSON (Railenium)	<b>Status:</b>	Postdoctoral position
<b>Scientific supervision:</b>	Julie BEUGIN (IFSTTAR/COSYS/ESTAS) Mohamed SALLAK (UTC/Heudiasyc) Walter SCHÖN (UTC/Heudiasyc)		
<b>Localisation:</b>	Valenciennes (travels to Villeneuve d'Ascq and Compiègne)	<b>Annual gross salary:</b>	~ 35 k€
<b>Start:</b>	January 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.

Through the SmartRaCon consortium, composed with the German Research Centre DLR (leader of the consortium), the Spanish Technology Centre CEIT and the British Company NSL, Railenium is an Associate Member on Innovation Programme (IP) 2 (Advanced Traffic Management and Control Systems) of the Joint Undertaking Shift2Rail. SmartRaCon is the only partner coming from academia.

The activities on IP2 are implemented through different projects. The "X2Rail-1" project, started in September 2016, allowed the start of 6 work packages. The "X2Rail-2" project started in September 2017 and involves 19 partners from the Railway sector coming from 9 countries (France, Germany, Belgium, Austria, Britain, Sweden, Spain, Italy, and the Czech Republic). The project covers different topics through 4 technical workpackages (WP):

- WP3: Fail Safe Train positioning (including satellite technology)
- WP4: On Board Train Integrity
- WP5: Formal Methods and standardisation for smart signalling systems
- WP6: Traffic Management evolution

Railenium is involved in these 4 WPs.

**Work context:**

This position is in the framework of the WP3 of the X2Rail-2 project. Railenium will fund it assuring a scientific supervision together with the ESTAS lab of IFSTTAR and the Heudiasyc lab of UTC. In this project, the WP3 aims to develop a safe on-board positioning system including satellite localisation technologies to enable the ETCS, the European Train Control System, to manage rail traffic safely. Global Navigation Satellite System (GNSS) technologies combined with existing odometry techniques are planned to allow a train to be located with on-board equipment rather than with ground-based equipment that are expensive to deploy and maintain (e.g. beacon). Railenium will contribute to this WP by investigating, on the one hand, integrated multi-constellation positioning techniques to design a powerful embedded solution. On the other hand, the IRT will contribute to the certification methods to be implemented for this TPS system (Train Positioning System). This position refers to the second point.

**Missions**

**Work description:**

The objectives of the work proposed in this post-doctoral offer are:

- To propose criteria that describe quantitative safety requirements for the TPS. The risky situations considered to formulate these criteria will be those in which the failure of the TPS leads to a possible train collision or derailment. We will focus in particular on the disturbances of the GNSS signals that can cause an excessive position error, i.e. an error outside a limit in meters accepted by the user (called position failure), that could lead to this risk. Today,

various safety mechanisms are included in the TPS to detect these situations. The hazard then refers to the missed detections of position failures. In other words, the confidence interval in meters associated with the estimated position, resulting from these mechanisms, does not correctly bound the true position of the train. For example, a confidence interval of up to 20 meters may allow managing safely the train spacing as the movement authority sent to the train by the radio centre (RBC) may include such a safety margin;

- To define a safety assessment method with the two intentions described below. This method will be carried out in steps, initially using theoretical cases, and secondly, using quantitative inputs reflecting real situations from the X2Rail-2 project or previous projects (ex. frequency of occurrence of failed or incorrectly bounded positions using datasets).

The selected applicant will be in charge of:

- Participating in various coordination meetings;
- Potentially participating in the project meetings with all European partners;
- Contributing to the achievement of deliverables and scientific publications.

**Detailed mission:**

Defining criteria capable of describing quantitative safety requirements related to the TPS is needed. Indeed, it is not possible today to use a value for characterizing the hazard rate per hour (criterion commonly used in railway safety) of the occurrence of the following events: "GNSS signals experience disturbances leading to a position failure" or "position failure due to GNSS signal disturbances not detected by the TPS". Imprecise rates or probabilities seem suitable to express the imperfect knowledge associated with the evoked occurrences.

The proposed method for evaluating this type of criteria will be able to:

- Combine imprecisions on the rate/probability of position failure with other rates/probabilities of safety-related events present in the control-command system in which lies the localization system, the ETCS. The intention here is to stand into an operational scenario defined for the ETCS and for which the GNSS has an impact, in order to conduct the evaluation.
- Consider that there are several zones on a railway line, each of which can be associated with imprecise of rate/probability depending on the type of disturbance affecting the position. The intention here is to conduct the evaluation for a given railway line. On this line, the considered imprecision can therefore evolve over time.

The different facets of the safety assessment method will thus aim at providing safety-related arguments for the certification of the localization system used within ETCS.

This work will be able to delve deeper what has been proposed in the European projects such as STARS and ERSAT-GGC in which the members of the supervising team are involved. The STARS project benefits from a GNSS database recorded on various existing railway lines and several analyses related to these data. The ERSAT-GGC project is currently elaborating a classification of each track part of a railway line to obtain "red" zones (risky zones having too high position error with a high probability of non-detection), "yellow" zones where the error of position is gradually degrading, and "green" zones free of risk.

<b>Skills</b>	
<b>Knowledge</b>	<b>Know-how</b>
<ul style="list-style-type: none"> <li>- PhD. Degree in automation engineering, computer science or applied mathematics; or equivalent level, in particular for the foreign applicants (publications, attendance to projects, teaching)</li> <li>- Knowledge in dependability and safety, system analysis and modelling tools, probabilistic evaluation tools</li> <li>- Experience in any of the following topics will be appreciated: satellite localisation, railway signalling system</li> <li>- Fluent English</li> </ul>	<ul style="list-style-type: none"> <li>- Sense of initiative</li> <li>- Autonomy / teamwork</li> <li>- Excellent relationship</li> <li>- Creativity, rigor, organization</li> <li>- Self-training capacity</li> <li>- Synthesis, reactivity</li> <li>- Availability (travel required)</li> <li>- Writing skills</li> </ul>

The application (Resume and cover letter) have to be addressed by e-mail as soon as possible, under the reference VN 2018/18, to [recrutement@railenium.eu](mailto:recrutement@railenium.eu).