



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 38th cycle

Research Area n. 2 - Sustainable Mobility

PNRR\_352 Research Field: UNMANNED RAILWAY VEHICLE FOR AUTOMATIC  
PATROLLING OF RAILWAY LINES

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1400.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## Context of the research activity

**Motivation and objectives of the research  
in this field**

Due to increasing level of risk for sabotage, vandalism or terrorist attacks the needing of inspecting railway lines overnight before the re-starting of the daily service, has become crucial for the infrastructure operator (in Italy Rete Ferroviaria Italiana, RFI). The Unmanned Railway Vehicle (URV) is equipped with vision systems, able to detect illicit objects on the rail. The vehicle powertrain has to guarantee high performance both in term of compactness and maximum speed, since it has to reach 200 km/h. The vehicle is a Battery Electric Vehicle with a Range Extender used both for emergency (out of energy) and for peak power consumption (uphill running at very high speed). The target of the research is the study of innovative solutions for improving the performance of the demonstrator that has been realized. Specifically, the candidate will have to assist the testing phase of the demonstrator both on a roller rig and on the real line and starting from the collected data to completely review the project, in term of sizing of the main components, in term of control algorithms of the hybrid powertrain and generally of the control algorithms of the whole vehicle. The vehicle is highly redundant in order to avoid the occupancy of the line in case of fail and this aspect is crucial to be guaranteed bot in the hardware of the powertrain and in its control (i.e. an automatic procedure



	to reconfigure the powertrain is necessary in the case a component fails). All the activities must be supported using the state of the art techniques in term of vehicle modelling, Software in the Loop techniques and in term of validation of the results.
<b>Methods and techniques that will be developed and used to carry out the research</b>	The research will be carried out mainly from an experimental point of view. A large set of data regarding the demonstrator will be collected and made available for the analysis of its performance. The analysis of these represents the basis of the work: different scenarios will be analyzed with different approaches in order to highlight the weakness of the demonstrator. These data will be furthermore used to tune up and to validate the numerical models that will be used to review completely the powertrain of the vehicle. Particular attention finally will be given to the analysis of the sliding condition that will be analyzed numerically. The research will be carried out in cooperation with a set of industrial partner that will cooperate in the redesign of the new vehicle on different topics (i.e. chassis design, boogie design, battery manufacturing, ...).
<b>Educational objectives</b>	Combine and master different modelling techniques; develop competences on innovative components; develop team-working attitude.
<b>Job opportunities</b>	Rolling stock manufacturer (i.e. Hitachi Rail); railway infrastructure operator (i.e. RFI); manufacturer of electric vehicle (cars or operating machines).  Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the same field.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 0 Assistant Professors 0 PhD Students
<b>Name of the research directors</b>	Prof. Davide Tarsitano, Prof. Marco Boccione



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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Rete Ferroviaria Italiana
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Technical University of Graz
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of 5.707, 13 euro.
Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.