



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

Research Area n. 2 - Sustainable Mobility

PNRR\_352 Research Field: ADVANCED NVH MODELLING

**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**

Sustainable mobility, as defined in the European Sustainable Development Strategy adopted by the European Council in 2006, aims to ensure that transport systems meet the economic, social, and environmental needs of society, at the same time minimising the negative impact on economy, society and environment. According to the Regional Office for Europe of the World Health Organization, environmental noise is an important public health issue, featuring among the top environmental risks to health. Road traffic is the dominant source of environmental noise, with an estimated 100 million EU citizens affected by harmful levels. Consequently, vehicle noise regulations are getting more and more stringent. At the same time, the need to preserve the health and well-being of passengers and the market expectations in terms of acoustic comfort inside a vehicle cabin, leads to an increasing attention of the automotive industry not only to exterior noise but also to interior noise issue. This results in a growing need for innovation in the field of vehicle NVH. The ongoing electric vehicle revolution and the consequent reduced contribution of the powertrain and other sound sources (such as the air intake and exhaust systems), exalts the importance of tyre/road interaction as the dominant contributor to vehicle exterior and interior noise. Tyre manufacturers are putting a big effort to produce tyres



	<p>with improved NVH performances and acoustic design is becoming one of the key elements for the competitiveness of the tyre industry. The challenge of making tyres more and more silent requires developing advanced simulation tools to support the development of future products. The PhD scholarship is awarded by Pirelli Tyre, within the framework of the Pirelli-PoliMi Joint Labs agreement.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>Physical acoustic modelling of the footprint region and of the radiated sound field, based on finite element simulation; exterior noise simulation including vehicle influence; finite element simulation of tyre structural dynamics; cabin interior noise simulation based on tyre/vehicle coupled models; indoor/outdoor testing and model validation.</p> <p>The candidate shall contribute to the development of advanced simulation tools. He/she will take part in experimental activities, to collect the necessary data for the advancement of the research and to allow for the validation of the proposed numerical models.</p>
<p><b>Educational objectives</b></p>	<p>The candidate will acquire high-profile skills and will be working on one of the most significant and challenging problems in NVH engineering, dealing with both theoretical and experimental methodologies. He/she will become an expert in advanced NVH modelling and experimental testing, including signal processing and system identification. The candidate is supposed to provide original contributions to the development and experimental validation of innovative simulation tools.</p>
<p><b>Job opportunities</b></p>	<p>Future job opportunities are primarily in the automotive field (especially in NVH area), i.e. R&amp;D departments of automotive industries (including automobile manufacturers, tyre manufacturers and vehicle component suppliers in general). Besides this, job opportunities comprise national and international academic and nonacademic institutions and organizations, engaged in innovation, research and technical development. Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to</p>



	Master of Science holders in the same field.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 0 Assistant Professors 3 PhD Students
<b>Name of the research directors</b>	Prof. Roberto Corradi

<b>Contacts</b>	
<i>Phone:</i> +39 02 2399 8493 <i>Email:</i> roberto.corradi@polimi.it	
phd-dmec@polimi.it, +39 02 2399 8555	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Pirelli Tyre S.p.A.
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	Pirelli Deutschland GmbH
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p>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 euro 5.707, 13.</p> <p>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.</p>



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

Research Area n. 3 - Engineering Design and Manufacturing for the Industry of the Future

PNRR\_352 Research Field: BATTERY MANUFACTURING FOR FUTURE MOBILITY

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

**€ 1325.0**

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**

The new global scenario emerged in the last few years calls for accelerating the twin (i.e., green and digital) transition. A paradigm shift to address various challenges including digital production, big data analysis and artificial intelligence, global production sustainability and circular economy, climate changes and smart cities is required. In this framework, advanced, smart, and sustainable manufacturing processes and systems act as key enabling technologies for providing high-precision, high-value, and high-performance custom-designed components at minimum waste. The transition towards a climate-neutral Europe requires fundamental changes in the way energy is generated and used. Batteries are a key technology for limiting carbon dioxide emissions from the transport, industry, and power sectors. To deploy batteries on a vast scale, they must be commercially successful, support scalability and cost-effective large-scale production. The research activity carried out with this scholarship can specifically focus on one or more subtopics within these main research frameworks:

- *Battery manufacturing for future mobility: smart and high volume laser manufacturing processes of solid state electrodes for rechargeable battery cells*
- *Battery manufacturing for future mobility: design and control of flexible assembly systems for high speed and high accuracy assembly processes of solid state*



	<p><i>rechargeable battery cells</i></p> <ul style="list-style-type: none"> <li>• <i>Battery manufacturing for future mobility: high speed process monitoring, inspection, and control for manufacturing processes of solid state rechargeable battery cells</i></li> </ul> <p>The described research activities are coherent with three of the six major areas of intervention (pillars) on which the PNRR will have to focus and in particular:</p> <ul style="list-style-type: none"> <li>• Green transition</li> <li>• Digital transformation</li> <li>• Smart, sustainable and inclusive growth</li> </ul>
<b>Methods and techniques that will be developed and used to carry out the research</b>	Rigorous experimental methods, physical models, and numerical simulations will be combined to design, implement, and validate the innovative solutions proposed. Team-working will be stimulated with the aim of providing appropriate solutions to actual challenges, which require multidisciplinary skills.
<b>Educational objectives</b>	Doctoral candidates will acquire competences on design, optimisation, and sensing/controlling of new advanced manufacturing processes and systems.
<b>Job opportunities</b>	Italy and Lombardy Region have leading positions in manufacturing worldwide. 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>	7 Full Professors 7 Associated Professors 9 Assistant Professors 30 PhD Students
<b>Name of the research directors</b>	Prof. Colosimo, Matta, Moroni, Previtali

<b>Contacts</b>
<p>Research Directors:</p> <ul style="list-style-type: none"> <li>- Prof. Bianca Maria Colosimo</li> <li>- Prof. Andrea Matta</li> </ul>



- Prof. Giovanni Moroni
- Prof. Barbara Previtali

phd-dmec@polimi.it

**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	662.5 €
By number of months	6

**National Operational Program for Research and Innovation**

Company where the candidate will attend the stage (name and brief description)	Comau S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	TUM Munich (or) Shanghai Jiao Tong University (or) Georgia Institute of Technology
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 euro 5.401, 42.

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.



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

**Research Area n. 2 - Sustainable Mobility**

**PNRR\_352 Research Field: BEYOND 5G FOR ENABLING AUTOMATED DRIVING IN  
RELEVANT OPERATIONAL DESIGN DOMAINS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1325.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>With reference to DM 352 dated 9-4-2022, the PhD researcher objectives will address the Missions 1 and 4 of the National Plan for Restart and Resilience - PNRR (Piano Nazionale Ripresa e Resilienza. Mission 1 of PNRR focuses on digital transition and competitiveness of productive chains. The PhD researcher will aim to develop automated driving in roundabouts or other relevant operational design domains. Mission 4 of PNRR focuses on filling the gap of education and fostering technology transfer. The PhD researcher will aim to become expert in the field of driving simulator technology and automotive connectivity.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>The first year the PhD researcher will focus on driving simulator technology within use case 1 of the EU project AI@EDGE. He/she will spend nearly six months in Turin during the first year, provided that more detailed timing will be agreed. He/She will spend part of the second year at Stellantis premises to acquire connectivity competences. Some time could be spent in Milan. He/She will spend the last year to wrap up the different competences and define quantitatively the challenges for automated vehicles exploiting post 5G technology.</p>
<b>Educational objectives</b>	<p>Hard skills: driving simulator technology, automotive</p>



	connectivity; artificial intelligence for quick computations and optimization Soft skills: team leadership, problem solving, dissemination, communication and outreach activities, networking, research fund procurement and management
<b>Job opportunities</b>	Job opportunities are available in the automotive industry, academia, regulating bodies.  The AI@EDGE Consortium involves the following institutions and companies: Telecom, Ericsson, Stellantis, Univ Grenoble, Uni. Polit delle Marche, INRIA, lund Univ., Italtel.
<b>Composition of the research group</b>	2 Full Professors 2 Associated Professors 2 Assistant Professors 10 PhD Students
<b>Name of the research directors</b>	Prof. Gianpiero Mastinu, Prof. Federico Cheli

#### Contacts

Prof. G Mastinu, via Privata Giuseppe La Masa 2, 20156 Milano  
  
phd-dmec@polimi.it

#### Additional support - Financial aid per PhD student per year (gross amount)

<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

#### Scholarship Increase for a period abroad

<b>Amount monthly</b>	662.5 €
<b>By number of months</b>	6

#### National Operational Program for Research and Innovation

<b>Company where the candidate will attend the stage (name and brief description)</b>	Centro Ricerche Fiat
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	STELLANTIS N.V.
<b>By number of months abroad</b>	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 euro 5.401,42.

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.



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

Research Area n. 2 - Sustainable Mobility

**PNRR\_351\_PUBBL\_AMMIN Research Field: ENVIRONMENTAL AND ECONOMIC  
ASSESSMENT OF THE ENERGETIC TRANSITION IN TRANSPORT SECTOR THROUGH  
CLEAN FUELS FROM RENEWABLE SOURCES (BIO-FUELS, HYDROGEN, E-FUELS)**

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

**€ 1325.0**

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**

This research addresses the challenges that the public administrations are facing in order to plan and to govern a feasible **energetic transition toward sustainable mobility** and new modes of transport (e.g. electric and hydrogen vehicles). The PhD will contribute to renew competences and instruments with the final goal to improve public administration governance and management capacities. Particularly, in the transportation sector, several strategies have been adopted to assure a smooth transition to achieve the goal of decarbonised transport such as investments to promote modal shift toward public transport, cycling and shared modes, as well as funding programmes to incentivize the use of clean fuel vehicles (electric, Hydrogen, hybrid) and autonomous driving ones (AVs). The above-mentioned policies need to be carefully assessed and duly planned, in order to facilitate an effective transition toward green mobility without inefficiencies and other undesirable indirect counter-effects. This research programme aims at developing an overall framework to assess transport policies towards a zero-carbon emission transport at the regional scale, that would critically analyse emerging innovations, contextualizing them in the Italian context and would assess the contribution of innovations on



	overall sustainability (environmental, economic and social), including also an assessment of the associated risks.
<b>Methods and techniques that will be developed and used to carry out the research</b>	The research will be conducted in collaboration with the Technical Unit of the Ministry of Sustainable Infrastructure and Mobility (MIMS). To carry out this research the following methods and techniques will be developed: Life-cycle assessment and multi-criteria analyses, in order to assess the economic and environmental impact of investments in new vehicles and fuels; advanced discrete choice models, in order to simulate travellers' behaviour, attitudes and perceptions about innovative technologies and new modes of transport; traffic assignment models (micro and macro), in order to simulate the impacts of new vehicles (e.g. electric vehicles) on transport networks;
<b>Educational objectives</b>	The project will provide candidate with: knowledge of the transportation sector, particularly the impact assessment of technologies; methodological competences at both the theoretical and applied level; problem setting and solving capabilities; capabilities to interact with people of diverse background.
<b>Job opportunities</b>	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>	2 Full Professors 1 Associated Professors 2 Assistant Professors 2 PhD Students
<b>Name of the research directors</b>	Prof. Pierluigi Coppola

<b>Contacts</b>
<i>E-mail:</i> pierluigi.coppola@polimi.it <i>Phone:</i> +39 02 2399 8376
<a href="https://www.mecc.polimi.it/ricerca/personale-docente/personale-docente/prof-pierluigi-coppola">https://www.mecc.polimi.it/ricerca/personale-docente/personale-docente/prof-pierluigi-coppola</a>

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

Scholarship Increase for a period abroad	
Amount monthly	662.5 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Ministero delle Infrastrutture e della Mobilità Sostenibile (MIMS)
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Universidad de Cantabria
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>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 euro 5.401, 42.</p> <p>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.</p>



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

Research Area n. 2 - Sustainable Mobility

PNRR\_352 Research Field: MATHEMATICAL, PHYSICAL AND NUMERICAL MODELS OF  
OPTIMAL CARBON BRAKES FOR HIGH PERFORMANCE VEHICLES

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

**€ 1325.0**

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**

With reference to DM 352 dated 9-4-2022, the PhD researcher objectives will address the Missions 1 and 4 of the National Plan for Restart and Resilience - PNRR (Piano Nazionale Ripresa e Resilienza). Mission 1 of PNRR focuses on digital transition and competitiveness of productive chains. The PhD researcher will aim to develop digital twins to compute efficiently the active safety performance of high-performance road vehicles, reducing stopping distances. Mission 4 of PNRR focuses on filling the gap of education and fostering technology transfer. The PhD researcher will aim to become expert in the field of computational multi-physics systems and become team leader thanks to acquired soft skills during secondments at company sites.

**Methods and techniques that will be developed and used to carry out the research**

High performance computing is needed to deal with digital twins of complex mechanical and multi-physics systems. The aim is to avoid as much as possible time domain simulations that are often too time consuming and do not allow an insight into phenomena. The candidate will study advanced computational mechanics techniques spanning from FEM to CFD. He/she will rely on artificial intelligence techniques (supervised learning) to define efficiently and in a reduced time the best engineering solutions for mechanical and multi-physics systems.



<b>Educational objectives</b>	Hard skills: computational Multiphysics systems, artificial intelligence for quick computations and optimization Soft skills: team leadership, problem solving, dissemination, communication and outreach activities, networking, research fund procurement and management
<b>Job opportunities</b>	Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field.
<b>Composition of the research group</b>	2 Full Professors 2 Associated Professors 1 Assistant Professors 5 PhD Students
<b>Name of the research directors</b>	Prof. Massimiliano Gobbi, Prof. Gianpiero Mastinu

<b>Contacts</b>	
<i>Phone:</i> +39 02 2399 8289 / 8214	<i>Email:</i> gianpiero.mastinu@polimi.it, massimiliano.gobbi@polimi.it
phd-dmec@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	662.5 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Brembo S.p.A.
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	University of Cranfield
<b>By number of months abroad</b>	6

**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information**



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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.



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

**Research Area n. 2 - Sustainable Mobility**

**PNRR\_352 Research Field: METHODOLOGIES FOR EVALUATING THE WIND SPEED  
ALONG RAILWAY LINES AND THE RISK OF TRAIN OVERTURNING DUE TO CROSSWINDS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1400.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>The research activity is related to Mission n.3, C1 of PNRR (Piano Nazionale di Ripresa e Resilienza), focusing on investments on railway infrastructures. The activity aims at the development of new simplified methods for evaluating the overturning risk due to crosswind to increase safety and efficiency of railway lines for high-speed and conventional trains, as well as freight trains.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>Current approaches for vehicle dynamics modelling and wind simulations will be applied and extended as part of the project. In particular, the student will:</p> <ul style="list-style-type: none"> <li>• analyse and develop numerical models/experimental techniques, characterised by different levels of complexity and precision, useful for the probabilistic assessment of the wind speed along the railway line;</li> <li>• study and compare different vehicle dynamics models for evaluating the overturning risk of a train under crosswind;</li> <li>• develop and implement a dedicated software, for the extended use of the simplified methodology to railway lines;</li> </ul>





<b>Educational objectives</b>	The student will learn: research project management and publishing skills; analytical models and experimental tests development skills (particularly numerical models for wind probabilistic assessment, multi-body models for vehicle dynamics simulation, measurements of wind-vehicle relative velocity/aerodynamic characteristics by full scale/wind tunnel tests); presentation and teaching skills.
<b>Job opportunities</b>	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. Companies in the transportation sector (RFI but also Mercitalia Intermodal, Trenitalia and Hitachi Rail, Bombardier, Alstom) who have been collaborating for years with the POLIMI research group, will be very interested in hiring a PhD-graduate with application experience in the sector.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 2 Assistant Professors 1 PhD Students
<b>Name of the research directors</b>	Prof. Gisella Marita Tomasini

<b>Contacts</b>	
<i>Phone:</i> 0223998480 <i>E-mail:</i> gisella.tomasini@polimi.it	
phd-dmec@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Rete Ferroviaria Italiana S.p.A.
<b>By number of months at the company</b>	6
<b>Institution or company where the</b>	University of Birmingham (or) Central South University (or) NablaFlow



<b>candidate will spend the period abroad (name and brief description)</b>	
<b>By number of months abroad</b>	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 euro 5.707, 13.

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.



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

Research Area n. 2 - Sustainable Mobility

**PNRR\_352 Research Field: OPTIMISATION OF SMART SENSORS FOR PREDICTIVE AND  
CONDITION-BASED MAINTENANCE OF RAILWAY WHEELSETS**

**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**

The research activity aims at developing infrastructures for sustainable mobility and, in particular, focuses on the development of innovative solutions to support condition-based maintenance (CBM) and predictive maintenance of railway wheelsets, with the aim of increasing the level of reliability and safety and reducing operating costs.

**Methods and techniques that will be  
developed and used to carry out the  
research**

Current smart sensor technology will be applied and extended as part of the project. In particular, the student will:

- optimise intelligent sensor solutions based on i.e. accelerometers, strain gauges, GPS, equipped with a microprocessor for real-time data processing, data storage and GSM connectivity, starting from solutions already studied in previous projects;
- develop autonomous power supply solutions (i.e. vibration harvester, solar), optimizing functionality and consumption;
- optimise the algorithms for processing the acquired signals to determine representative parameters for the identification of defects on wheelset and on the railway line;



	<ul style="list-style-type: none"> <li>develop predictive models able to capture the evolution of defects with the service to optimize vehicle maintenance stops;</li> </ul>
<b>Educational objectives</b>	The student will learn: research project management and publishing skills; analytical models and experimental tests development skills (particularly identification algorithms, autonomous power supply solutions); presentation and teaching skills.
<b>Job opportunities</b>	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. Companies in the transportation sector (Lucchini but also Bombardier, Alstom, Mercitalia Intermodal, Trenitalia,) will be very interested in hiring a PhD-graduate with application experience in the sector.
<b>Composition of the research group</b>	1 Full Professors 2 Associated Professors 1 Assistant Professors 1 PhD Students
<b>Name of the research directors</b>	Proff. Francesco Castelli Dezza, Gisella Tomasini

<b>Contacts</b>	
<i>Phone: 0223998480 Email: gisella.tomasini@polimi.it</i>	
phd-dmec@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Lucchini RS S.p.A.



<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	Lucchini Sweden AB (or) Chalmers University
<b>By number of months abroad</b>	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 euro 5.707, 13.

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.



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

Research Area n. 3 - Engineering Design and Manufacturing for the Industry of the Future

**PNRR\_352 Research Field: REPURPOSING STRATEGIES OF AUTOMOTIVE LI-ION BATTERIES FOR SECOND-LIFE BATTERY PRODUCTS**

**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**

Free2Move eSolutions, a joint venture between the Stellantis group and NHOA (formerly Engie EPS), is co-funding a scholarship on the subject of second-life batteries to boost its grounding in this market and to develop long-term scientific-academic cooperations. The automotive sector is undergoing a critical transformation from internal combustion engines to fully electrified propulsion systems. The key enabling technology behind this shift is represented by Li-ion batteries, whose price has come down significantly over the last two decades. The rapid uptake of electric vehicles (EV) by motorists worldwide is however poised to leave a substantial amount of stranded assets in the form of spent batteries at the end of their vehicular life. Collecting and recycling these batteries represents both a cost and a logistical liability for car manufacturers and EV owners. For this reason, several companies are looking into ways to reuse and repurpose said batteries into less demanding energy storage devices as Second-Life Batteries (SLB). The main uncertainties linked to battery repurposing revolve around their state of health (SOH) and the remaining useful life (RUL) left inside the device, and how that metric impacts the decisional tree that can lead to either refurbishing, repurposing, or recycling. OEMs like Stellantis equip PHEVs and BEVs in their portfolio with as many as 10



	<p>differing battery packs, with cells coming from competing manufacturers and consisting of different cell size, cell chemistry, module arrangement, and thermal behaviour. This extreme heterogeneity begs the need for a differentiated approach based on all these differences to develop a unifying algorithm to make informed decisions on the optimal strategy worth pursuing in each scenario. The aim of this project is to investigate SOH estimation methods applicable to commercial automotive battery packs, combining state-of-the art battery testing instruments as well as experimental techniques and machine learning algorithms. The outcome of this study will then be applied to develop a Decision Support System that takes into account battery degradation, remaining useful life, cell-to-cell heterogeneity, battery pack configuration, ease of disassembly, and other relevant parameters, to configure second-life modules and packs, thus guiding stakeholders identifying the best possible path to pursue in real-life commercial scenarios. The algorithm may be ultimately deployed in Free2Move eSolutions' existing battery sorting pipeline to be verified in a real-life scenario and to improve the company's industrial processes.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The project will be articulated into the following phases:</p> <ol style="list-style-type: none"> <li>1. Survey of existing and future automotive battery pack architectures, including their assembly and disassembly methodologies;</li> <li>2. Market analysis of Second-Life Battery products as well as the battery recycling sector;</li> <li>3. Study of SOH and RUL estimation strategies in the context of automotive battery packs;</li> <li>4. Commercial battery data acquisition and processing;</li> <li>5. Experimental comparison of SOH and RUL appraisal strategies;</li> <li>6. Definition of a battery classification algorithm based on residual commercial value and other useful metrics;</li> <li>7. Deployment of the decision support algorithm and validation in an industrial setting;</li> </ol> <p>The project will make use of a combination of computational and experimental techniques to accomplish</p>



	<p>its goal. These include and are not limited to:</p> <ul style="list-style-type: none"> <li>• Battery simulation and modelling (Python, Matlab)</li> <li>• Battery cycling</li> <li>• Battery testing</li> <li>• Battery disassembly and reverse-engineering</li> </ul> <p>Free2Move eSolutions and its parent company NHOA will grant the PhD student access to their state-of-the art facilities to make use of dedicated testing instruments as well as testing pipelines. The project will make use of a combination of computational and experimental techniques to accomplish its goal. These include and are not limited to:</p> <ul style="list-style-type: none"> <li>• Battery simulation and modelling (Python, Matlab)</li> <li>• Battery cycling</li> <li>• Battery testing</li> <li>• Battery disassembly and reverse-engineering</li> </ul> <p>Free2Move eSolutions and its parent company NHOA will grant the PhD student access to their state-of-the art facilities to make use of dedicated testing instruments as well as testing pipelines.</p>
<p><b>Educational objectives</b></p>	<p>The goal of this work is to leverage the academic excellence of Politecnico di Milano to craft an industrial decisional tree that can better inform stakeholders and decision makers in the e-mobility space on the opportunities and faux pas in battery reuse, repurpose, and recycling.</p>
<p><b>Job opportunities</b></p>	<p>The EU's Fit for 55 package and the ambitions of the Chinese government over the nascent e-mobility market make this PhD project an excellent entry point into a career that can be devoted to environmental sustainability and cutting-edge R&amp;D in the automotive sector. 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.</p>
<p><b>Composition of the research group</b></p>	<p>0 Full Professors 1 Associated Professors</p>





	5 Assistant Professors 7 PhD Students
<b>Name of the research directors</b>	Prof. Marcello Colledani

<b>Contacts</b>	
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phd-dmec@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
Amount monthly	700.0 €
By number of months	6

<b>National Operational Program for Research and Innovation</b>	
Company where the candidate will attend the stage (name and brief description)	eSolutions Free2Move S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	to be defined
By number of months abroad	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>	
<p>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 euro 5.707, 13.</p> <p>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.</p>	



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

Research Area n. 2 - Sustainable Mobility

**PNRR\_352 Research Field: SLIPSTREAM PHENOMENON DUE TO THE PASSAGE OF  
TRAINS ON THE PLATFORMS OF A STOP/STATION IN THE OPEN FIELD AND IN THE  
TUNNEL**

**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

<p><b>Motivation and objectives of the research in this field</b></p>	<p>The research activity is related to Mission n.3, C1 of PNRR (Piano Nazionale di Ripresa e Resilienza), focusing on investments on railway infrastructures. The research activity aims at the evaluation of the slipstream phenomenon considering the effect of confined spaces, train types, etc. and the corresponding effects on passengers on platform and on workers trackside.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>Current approaches for vehicle aerodynamics testing and simulation will be applied and extended as part of the project. In particular, the student will:</p> <ul style="list-style-type: none"> <li>• adopt CFD numerical models/experimental techniques (full scale tests) for the evaluation of the slipstream physical phenomenon and the probabilistic assessment of the effects on passengers and workers trackside;</li> <li>• identify the main parameters having an effect on the phenomenon;</li> <li>• develop a numerical/experimental methodology for the evaluation of the slipstream phenomenon in different sites and with different trains;</li> </ul>
<p><b>Educational objectives</b></p>	<p>The student will learn: research project management and</p>



	publishing skills; numerical models and experimental tests development skills (particularly CFD numerical models and full scale experimental tests); presentation and teaching skills.
<b>Job opportunities</b>	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. Companies in the transportation sector (RFI but also Mercitalia Intermodal, Trenitalia and Hitachi Rail, Bombardier, Alstom) who have been collaborating for years with the POLIMI research group, will be very interested in hiring a PhD-graduate with application experience in the sector.
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 2 Assistant Professors 1 PhD Students
<b>Name of the research directors</b>	Proff. Daniele Rocchi, Gisella Marita Tomasini

<b>Contacts</b>	
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phd-dmec@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Rete Ferroviaria Italiana S.p.A.
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	DLR Germany Aerospace Center (or) Monash University
<b>By number of months abroad</b>	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 euro 5.707, 13.

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.



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

Research Area n. 1 - Advanced Materials and Smart Structures

PNRR\_352 Research Field: STRUCTURAL HEALTH MONITORING AND PREDICTIVE  
MAINTENANCE OF RAILWAYS BRIDGE

**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**

The performance of bridges and infrastructural networks evolve over time because of damage caused by natural events (earthquakes, landslides, floods), anthropogenic actions (shocks, explosions, fires) and aging and progressive degradation phenomena (fatigue and corrosion). The difficulty of catching the triggering of some forms of degradation and progressive collapse phenomena requires an assessment of the life cycle of infrastructural works not only in terms of safety and reliability, but also with regard to other performance indicators. Safety, reliability and robustness are key parameters to control the design of individual components and structures, but in the case of bridges, an even broader vision is needed that takes into account the maintenance strategies and how its interaction with the structural health monitoring techniques. The objective of the research is therefore the development of methodologies and technological solutions for bridge monitoring in terms of safety, and interaction with the maintenance procedures; AI, big data and machine learning process will be used to support the management of critical infrastructure to develop sustainable and intelligent mobility of goods and people (Smart Infrastructure).



<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The design of effective monitoring systems for infrastructures requires a multidisciplinary approach, which combines the dynamics of the mechanical system with data analysis, to design algorithms that optimally combine signal processing and Machine-Learning skills with the knowledge of the process. A true integration of the skills will lead to new results of high scientific value, with strong repercussions on the industrial sectors of reference, thus allowing a precious technology transfer. The research topics will be developed through numerical and analytical modelling approaches, supported by experimental activities to allow a robust development of the identified technical solutions. The PhD student will use data coming from experimental tests on real bridges, so to put in practice developed algorithms on real datasets coming from infrastructure system.</p>
<p><b>Educational objectives</b></p>	<p>The PhD graduate will be able to: have a in depth mechanical knowledge of infrastructures systems, with reference to railway bridges; develop complex algorithms by mixing model-based approach and deep-learning strategies; critically analyze results coming from AI-based algorithms. We provide doctoral candidates with high-level scientific training, fostering and refining research and problem-solving abilities by focusing on both theoretical and experimental skills. A PhD in Mechanical Engineering will be able to layout, draft and carry-on original research, by leading a research group or working in a team.</p>
<p><b>Job opportunities</b></p>	<p>Job opportunities may be found in infrastructure companies, engineering societies, builders. Among the companies that are cooperating in the research Italferr, RFI, Regione Lombardia, ASPI, Milano Serravalle and RaiWay can be listed.</p>
<p><b>Composition of the research group</b></p>	<p>10 Full Professors 10 Associated Professors 15 Assistant Professors 20 PhD Students</p>
<p><b>Name of the research directors</b></p>	<p>Prof. Marco Belloli</p>

<p style="text-align: center;"><b>Contacts</b></p>	
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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)	--

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

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)	ITALFERR S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	6

Company where the candidate will attend the stage (name and brief description)	ITALFERR S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>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 euro 5.707, 13.</p> <p>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.</p>

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 euro 5.707, 13.

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.



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

Research Area n. 2 - Sustainable Mobility

**PNRR\_352 Research Field: TRAIN AERODYNAMICS, ANALYSIS OF THE AERODYNAMIC INTERACTION BETWEEN TRAIN AND TUNNELS TO OPTIMIZE THE DESIGN**

**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**

The design of the train structure and of its components must consider the aerodynamic loads produced by train-tunnel intersection and train-train crossings both in open air and in tunnel. Simulations are required to take into account of the issues such as the overpressure dependence on how trains cross together (trains speed, time delay, open air/tunnel) and on the different tunnel characteristics along the line. In addition, for the computation of the aerodynamic loads that depend on the differential pressure, the internal pressure has to be computed starting from the external one considering specific models for sealed and unsealed trains. Aim of this research is to develop and validate a code able to simulate the crossings of trains within a tunnel in order to estimate both the external and internal pressures. The idea is to start from the analysis of experimental data recorded both on-board and at trackside in order to develop proper models able to reproduce the pressure evolution along the tunnel and within the trains. The developed code will be tested for different railway lines and trains so that it can become a useful support for the design stage of new trains in order to increase safety and performance one hand and reduce costs and weight on the other.





<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The PhD candidate will identify the right models to reproduce the evolution of the pressure waves when one or more trains cross a tunnel. An initial analysis of the system and of all its components will be performed starting from experimental data already available or to be obtained through ad-hoc designed tests. In the next phase, the PhD candidate will develop a numerical code and a proper algorithm to estimate the pressure loads acting on the chassis of a train. Finally, the reliability of the results will be tested considering the actual trains running in different railway lines in order to solidly tests the code in different configurations varying all the parameters that affect the phenomenon (train speed, length and type, tunnel length, section and friction).</p>
<p><b>Educational objectives</b></p>	<p>The PhD candidate will be working in one of the most challenging research fields of railway aerodynamics. The PhD candidate will become an expert in advanced modelling belonging to different fields of engineering. The candidate is supposed to provide original contributions to the development and verification of numerical and experimental tools for simulating the evolution of the pressure within a tunnel and a train. The relationships established with international experts in this field will enable the candidate to develop the capability to cooperate within an international high level research team.</p>
<p><b>Job opportunities</b></p>	<p>Future job opportunities are primarily in the vehicle aerodynamics field, including railway companies or automotive industry, engineering companies, operators and infrastructure managers. In a more general way, the competence acquired will indisputably be of interest for R&amp;D departments of companies dealing with issues related to flow-infrastructure/vehicle interactions. Besides this, job opportunities will be with national and international academic and non-academic institutions and organizations, engaged in innovation, research and technical development. Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field.</p>



<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 2 Assistant Professors 2 PhD Students
<b>Name of the research directors</b>	Prof. Daniele Rocchi, Ing. Claudio Somaschini

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

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Hitachi Rail STS S.p.A.
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	Hitachi Rail STS UK Ltd
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>	
<p>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 euro 5.707, 13.</p> <p>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.</p>	



# 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>	Job opportunities include 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>	Proff. Davide Tarsitano, Marco Bocciolone

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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)	Graz University of Technology
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>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 euro 5.707, 13.</p> <p>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.</p>