



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

PNRR 630 Research Field: DEVELOPMENT OF AUTONOMOUS SENSORS AND ALGORITHMS BASED ON ARTIFICIAL INTELLIGENCE TECHNIQUES FOR THE CONDITION-BASED MAINTENANCE OF RAILWAY WHEELSETS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0
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	<p>Infrastructures for sustainable mobility. 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.</p>
Methods and techniques that will be developed and used to carry out the research	<p>Current smart sensor technology will be applied and extended as part of the project. These solutions, achieved through previous research projects with PoliMi, have reached a maturity level of TRL4 (Technology validated in the laboratory). Within the scope of the proposed Ph.D. programs, with the opportunity to extensively test innovative solutions on operating railway vehicles, the development aims to advance to TRL8 (Complete and qualified system) by identifying the following research topics: In particular, the student will:</p> <ul style="list-style-type: none"> •optimize intelligent sensor solutions (i.e., accelerometers, strain gauges, GPS) (equipped with microprocessors for real-time data processing, memory, and GSM connectivity) as a complement and addition to the two solutions currently already developed; •optimize the electric power management of the intelligent sensor based on different autonomous power supply solutions (i.e., vibration harvester, solar, battery) and integration with the sensors themselves, optimizing



	<p>functionality and consumption;</p> <ul style="list-style-type: none"> •develop of predictive models using artificial intelligence and machine learning techniques, capable of detecting in an advance defects and their evolution in service in order to better schedule maintenance stops of the vehicles; the typical defects will be: wheel rolling surface wear and rolling contact fatigue damages, bearing fatigue damages, wheelset axle fatigue cracks. •Development of data management solutions based on data analytics techniques; in particular, the development will focus on correlating the generated data with operating conditions to be able to predict the evolution of defects, correlated to the signals themselves, over time; •Development of data communication techniques between sensors and cloud servers, aiming to optimize the transmission of acquired data packets and verify their integrity and consistency on the server side.
<p>Educational objectives</p>	<p>The student will learn:</p> <ul style="list-style-type: none"> - research project management and publishing skills; - analytical models and experimental tests development skills (particularly identification algorithms, autonomous power supply solutions); - presentation and teaching skills.
<p>Job opportunities</p>	<p>Employment statistics of POLIMI PhDs can be found at: https://cm.careerservice.polimi.it/en/employment-statistics/</p> <p>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> <p>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.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 3 Associated Professors</p>



	3 Associated Professors 3 Assistant Professors 4 PhD Students
Name of the research directors	Proff. Francesco Castelli Dezza, Gisella Tomasini

Contacts	
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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	750.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Lucchini RS 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)	Chalmers University, Department of Mechanics and Maritime Sciences, Göteborg, Sweden
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 6.114,50.</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>	