



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**PNRR 117 Research Field: ON BOARD FREIGHT TRAIN MONITORING AND DIAGNOSTIC
SYSTEM**

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 main goal of the research is to increase the efficiency and safety of goods transportation on railways by designing and realizing an integrate on board freight train monitoring system which communicates and shares data/information also with the portals equipped with new technologies for train inspection and diagnostics. Thanks to the new smart on board system integrated in the railway wagon, the freight train will be able to know, every time, the status of each sub-system of the convoy, identify in advance malfunctions of parts of the subsystems (brake system, suspensions, wheelsets, etc.) and communicate them to the railway portals and to a remote-control center.

In terms of impact, the research will basically contribute to:

- increase the railway freight transport sharing;
- reduce the cost in maintenance of freight wagon;
- cut the number of trains taken out of service for maintenance.

The system will be composed by a "modular" platform, that includes variable compositions. It will be already prepared to take advantage of the future presence of the DAC technology. At the same time, the system could be easily scaled down to fulfill a minimum set of monitoring requirements with the aim of retrofitting old freight wagons. Finally, the "integrate" platform will be able to



	<p>manage and elaborate the information coming from possible existing devices already equipping the wagon with those collected by new sensors with the aim to reach the monitoring and diagnostic targets, depending on the technology level of the considered wagon.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research will be mainly focused on the development of an integrated and modular monitoring system to be mounted on-board freight wagons.</p> <p>In particular, the student will:</p> <ul style="list-style-type: none"> - analyze the instrumentation set-up mounted on already existing demo wagons and the corresponding datasets, with the aim of identifying feasible monitoring and diagnostic activities to be performed with the devices already available on those vehicles as well as new sensors to be implemented and integrated to reach the monitoring/diagnostics goals; - design the new set-up of the monitoring system in terms of type and number of sensors, power supply and energy harvesting technology, data communication protocols and integration will be defined and designed; - develop new suitable algorithms to identify defects or system malfunctioning on the basis of the data analysis performed. <p>Some possible monitoring and diagnostic activities to be pursued with the developed system are listed below:</p> <ul style="list-style-type: none"> - braking plant diagnostics with suitable algorithms; - wheelflats identification and root cause analysis on the basis of the simultaneous monitoring of braking plant and vehicle dynamics; - detection of an incipient derailment condition and development of the communication system to send a warning to the locomotive (wireless communication/DAC); - identification of local defects in mechanical components of the wagon (bogie, suspensions,...) on the basis of acceleration measurements and suitable algorithms. <p>The final expected result is the creation of a modular set-up necessary to perform all the monitoring activities.</p>
<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.
Job opportunities	<p>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>Companies in the transportation sector will be very interested in hiring a PhD-graduate with application experience in the sector.</p>
Composition of the research group	<p>1 Full Professors 2 Associated Professors 1 Assistant Professors 1 PhD Students</p>
Name of the research directors	Associate Professor Gisella Marita Tomasini

Contacts	
<p>Phone: 0223998480 Email: gisella.tomasini@polimi.it</p> <p>For questions about scholarship/support please contact phd-dmec@polimi.it.</p>	

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)	MERCITALIA INTERMODAL 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



By number of months abroad	6
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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.