



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 38th cycle

Research Area n. 1 - Computer Science and Engineering

PNRR_352 Research Field: ARTIFICIAL INTELLIGENCE FOR THE FLEETWIDE
MONITORING AND CONDITION-BASED MAINTENANCE OF RAILWAY WHEELSETS

Monthly net income of PhDscholarship (max 36 months)

€ 1250.0

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>Motivation and objectives of the research in this field</p>	<p>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>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Current Data Science technology will be applied and extended as part of the project. In particular, the student will:</p> <ul style="list-style-type: none"> - investigate methodologies for automating the analysis of received data from wheelset monitoring devices; - apply recent deep learning techniques (based on transformer-based and auto-encoder architectures) for the analysis of time series and the detection of anomalies; - apply eXplainable Artificial Intelligence (xAI) techniques as needed; - investigate user-interface solutions for displaying information on the status of components (health monitoring, and anomaly detection) deriving from data analysis, taking into account the necessary integration with fleet management and maintenance processes of vehicles.
<p>Educational objectives</p>	<p>The student will learn:</p> <ul style="list-style-type: none"> - research project management and publishing skills;



	<ul style="list-style-type: none"> - data science and data analytics skills (particularly deep learning and explainable AI skills); - and presentation and teaching skills. while developing into a professional researcher.
Job opportunities	Strong employment opportunities exist for PhD level Data Scientists with advanced skills in Deep Learning and experience in real-world applications. Companies in the transportation sector will be very interested in hiring a PhD-graduate with application experience in the sector.
Composition of the research group	0 Full Professors 2 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Prof. M.J.CARMAN Prof. A.Facchinetti,

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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	625.0 €
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 (https://lucchinirs.com/)
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Monash University, (Melbourne, Australia), Faculty of Information Technology and possibly also the Monash Institute of Railway Technology - Sector: Tertiary Education in Computer Science, research in Deep Learning (https://www.monash.edu/it)
By number of months abroad	6

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

**Attinenza alle tematiche, alle missioni/componenti prescelte del bando PNRR v. D.M. 352, art.6**

Con riferimento alla MISSIONE 3: INFRASTRUTTURE PER UNA MOBILITÀ SOSTENIBILE e in particolare alla componente M3C1: INVESTIMENTI SULLA RETE FERROVIARIA, questa borsa di dottorato prevede lo sviluppo e l'applicazione della tecnologia avanzata dell'intelligenza artificiale (es. deep self-attention networks) per il monitoraggio in tempo reale dello stato dei componenti nei mezzi ferroviari e la manutenzione più efficace ed efficiente dei veicoli, tramite la manutenzione condizionata sulla base delle effettive condizioni dei componenti critici del veicolo (es. asse, sale montate, ecc.), oltre a quella programmata in base alle normative vigenti.

Impresa, presso cui si svolgerà l'attività esterna

- Name: Lucchini RS S.p.A
- Planned months: 12 months
- Activity: Collection of datasets, experimental evaluation on railway vehicles in operation. Investigation of data-communication techniques between sensors and cloud servers, with a view to optimizing the sending of acquired data packets and verifying their integrity and consistency on the server side. Investigation of data management and data analytics solutions in order to be able to predict the evolution of defects over time.
- Collaborations: Lucchini RS SpA has been involved in providing data science projects for students in Mark Carman's "Data Science & Security for Mobility" course.

Ente, università, azienda, centro di ricerca presso cui si svolgerà il periodo di studio e ricerca all'estero

- Entity: Monash University, (Melbourne, Australia), Faculty of Information Technology and possibly also the Monash Institute of Railway Technology
- 6 months
- Activity: Investigation of current Deep Learning and traditional Machine Learning techniques for processing time series data in order to detect anomalous behaviour and predict maintenance requirements for rail components.
- Collaborations: Extensive past collaborations between Mark Carman and many AI researchers at Monash (Geoff Webb, Reza Haffari, Christoph Bergmeir, etc.)

All information regarding educational activities, personal funding, regulations and obligations of Ph.D. candidates are available on the web site <https://dottoratoit.deib.polimi.it/>