



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

THEMATIC Research Field: AERODYNAMICS OF HIGH-SPEED FREIGHT TRAINS

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	<p>Train operation faces many engineering problems, from train running dynamics and ride quality to aerodynamics and aeroacoustics. In particular, train aerodynamics and aeroacoustics still faces significant issues and research needs for both passenger and freight trains. Specifically, freight trains are faced with the challenge of significantly raising their speed, in order to achieve a better competitiveness with respect to other competing cargo transportation modes. While the long-term goal for the maximum speed of freight trains is in the range of 200 km/h, the speed of 160 km/h is envisaged for the near future and this PhD Programme aims to contribute to meet such objective. This PhD position aims at achieving an improved understanding of the aerodynamic effects, considering the specificities of freight trains, and to synthesize the knowledge gained in this research into recommendations for extending and improving existing standards for train aerodynamics, proposing freight train-specific criteria.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The aerodynamics of high-speed freight trains features specific challenges: freight wagons are not designed to have an aerodynamically optimised shape and instead behave as bluff bodies. Hence, modelling their aerodynamic behaviour is highly challenging and involves significant unsteady effects. In a first stage of her/his work, the PhD candidate will build a database of wagon geometries, considering the most common freight coach configurations. This approach has been successfully</p>



	<p>applied to the automotive industry with the DrivAer model and the ECoGet project for the commercial vehicle sector. Then the PhD will define multiple CFD models having different levels of complexity. For this purpose, relatively fast steady-state Reynolds-Averaged Navier-Stokes (RANS) models will be used for a first investigation of flow features for different representative freight wagon geometries, whilst unsteady Reynolds-Averaged Navier-Stokes (URANS) and Detached Eddy Simulation (DES) / Large Eddy Simulation (LES) models involving a larger computational cost will be used to investigate in detail drag and slipstream effects for some selected wagon geometries. The development of innovative CFD models will take advantage from the availability of experimental data including wherever possible full-scale measurements and advanced wind tunnel measurements. Altogether, these will provide a suite of validation data to support the confidence on the accuracy of the CFD models developed. The numerical models developed in this research are expected to support the design of future rolling stock and of improvements to existing vehicles e.g., fairings. Moreover, the guidelines developed during this research may be included in new versions of aerodynamic standards.</p>
<p>Educational objectives</p>	<p>The main educational outcomes the candidate is expected to gain in this project are:</p> <ul style="list-style-type: none"> - State-of-art skills regarding CFD numerical models, particularly for bluff bodies; - Understanding of the fundamentals of railway vehicle dynamics in regard to energy consumption, running safety and track loading; - research project management skills; - scientific communication and publishing skills; - presentation and teaching skills.
<p>Job opportunities</p>	<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>This research project is carried out as part of the HORIZON-ER-JU-2022-ExpIR-04 Academics4Rail</p>



	<p>project funded by the European Community under the Europe's Rail initiative (https://rail-research.europa.eu/). The candidate will benefit from intensive interaction with some of the industrial partners of this initiative and other companies from the railway sector who will be very interested to hire a PhD graduate with experience in this sector. The following universities and research centres will be directly involved in the research:</p> <ul style="list-style-type: none"> - Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Göttingen - Technische Universität Berlin, Fakultät V - Verkehrs- und Maschinensysteme - University of Huddersfield, Institute of Railway Research
Composition of the research group	<p>2 Full Professors 1 Associated Professors 1 Assistant Professors 3 PhD Students</p>
Name of the research directors	Prof. Stefano Bruni, Prof. Daniele Rocchi

Contacts

For questions regarding the research topic:
 Prof. Stefano Bruni (stefano.bruni@polimi.it), Associate Professor Paolo Schito (paolo.schito@polimi.it)

For questions about scholarship/support please contact 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	700.0 €
By number of months	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.



Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 700 euro/month- net amount).

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.