



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

**PNRR 630 Research Field: ACTIVE NOISE CONTROL AND SOUND QUALITY ENHANCEMENT WITHIN VEHICLE COMPARTMENTS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1500.0</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 advancement of technology in automotive has significantly enhanced driving experiences, yet the issue of cabin noise remains a persistent challenge. Interior noise, originating from powertrain, tires, and aerodynamic turbulence, can adversely affect passenger comfort, reduce speech intelligibility, and contribute to driver fatigue. Traditional passive noise control methods, such as insulation and damping materials, show their limitations in effectiveness and efficiency, especially at low-mid frequencies. Consequently, there is a compelling need to explore innovative solutions that can provide superior noise reduction without compromising vehicle weight or space. Active Noise Control (ANC) presents a promising alternative to conventional methods by utilizing destructive interference to cancel unwanted sound waves. The integration of ANC systems in vehicles aims to create a quieter and more pleasant cabin environment, enhancing overall passenger comfort and meeting the growing consumer demand for quieter vehicles. The primary objective of this research is to develop and optimize advanced ANC algorithms capable of real-time noise cancellation across a wide range of frequencies. These algorithms must be highly adaptable and robust to accommodate varying noise conditions and vehicle dynamics. Additionally, the research aims to integrate ANC systems within existing vehicle architectures, ensuring minimal impact on vehicle weight, power consumption and design. Another key objective is to</p>



	<p>conduct comprehensive assessments of ANC system performance in various driving conditions and environments. This includes measuring improvements in cabin noise levels, passenger comfort, and speech intelligibility. Investigating the psychological and physiological effects of reduced cabin noise on drivers and passengers is also essential to understand the overall impact on the driving experience and safety. Furthermore, the research explores the potential for ANC systems to reduce the need for heavy, resource-intensive soundproofing materials, thereby contributing to sustainability efforts. Evaluating the cost-benefit ratio of implementing ANC systems in mass-produced vehicles is crucial to determine their feasibility and economic viability. By addressing these objectives, this research aims to pioneer advancements in noise control within the vehicle compartment, contributing to the development of quieter, more comfortable and energy-efficient vehicles. The successful implementation of ANC technology could represent a new standard for in-cabin acoustic environments.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>This research is characterized by a strong interdisciplinary approach. To achieve the objectives of the research on active noise control (ANC) within vehicles, a comprehensive and systematic approach will be employed, utilizing the analytical, numerical, and experimental tools of PoliMi DMEC and the Polimi Sound and Vibration Laboratory (PSVL). The methods and techniques developed and employed will encompass several key areas, including algorithm development, system integration, performance evaluation, human factors analysis, and sustainability assessment. By employing these methods and techniques, the research aims to develop innovative and effective ANC solutions that significantly improve the acoustic environment within vehicles. The integration of cutting-edge technology, rigorous testing, and comprehensive evaluations will ensure that the resulting ANC systems meet the highest standards of performance, safety and sustainability.</p>
<p><b>Educational objectives</b></p>	<p>The candidate will acquire high-level skills and will work</p>



	<p>on one of the most significant and challenging problems in NVH engineering, addressing both theoretical and experimental methodologies. He/she will become an expert in Active Noise Control (ANC) modeling and experimental testing, including signal processing and system identification. The candidate is expected to provide original contributions to the development and experimental validation of innovative ANC tools.</p>
<b>Job opportunities</b>	<p>Future job opportunities primarily lie within the automotive sector, particularly in the NVH (Noise, Vibration, and Harshness) area, including R&amp;D departments of automotive industries such as automobile manufacturers and suppliers of vehicle components. Additionally, opportunities exist in national and international academic and non-academic institutions and organizations engaged in innovation, research, and technical development. Furthermore, according to our latest survey of MeccPhD Doctorate, there is a 100% employment rate within the first year, with salaries being 35% higher compared to Master of Science holders in the same field. Employment statistics of PhDs can be found at:  <a href="https://cm.careerservice.polimi.it/en/employment-statistics/">https://cm.careerservice.polimi.it/en/employment-statistics/</a></p>
<b>Composition of the research group</b>	<p>1 Full Professors                  1 Associated Professors                  0 Assistant Professors                  3 PhD Students</p>
<b>Name of the research directors</b>	<p>Prof. Francesco Ripamonti</p>

<b>Contacts</b>	
<p>Phone: +39 02 2399 8473 Email: Francesco.ripamonti@polimi.it                      For questions about scholarship/support:phd-dmec@polimi.it</p>	

<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>
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<b>Amount monthly</b>	750.0 €
<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>	Ferrari Spa
<b>By number of months at the company</b>	18
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	University of Southampton; RWTH Aachen University; Universitat Politècnica de València; Graz University of Technology; Silesian University of Technology
<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 € 6.114, 50. 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>