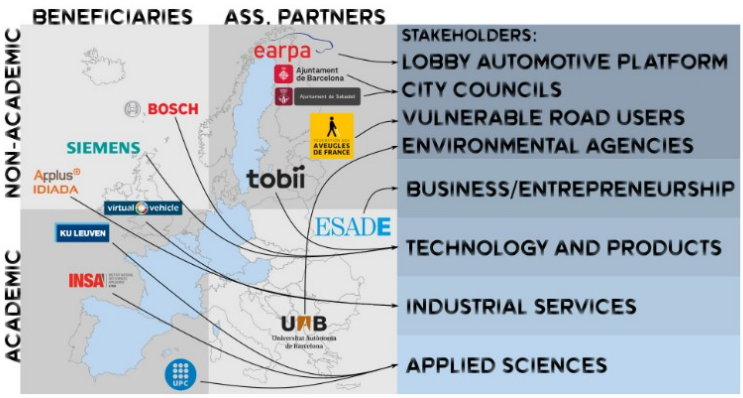
Funded by the European Union

NEWSLETTER # 4

"Global Acoustic interaction and Psychoacoustic impact of the autonomous vehicles in interior and exterior NOISE" (GAP_NOISE) is a Horizon Europe MSCA Doctoral Network that started on 1st March 2023.

GAP_NOISE aims to develop research and a training program to create a technologically strong community of scientists and engineers capable of boosting the integration of electric powertrains in future vehicles.



The GAP_NOISE project has now entered its second half, marking a significant milestone in our research journey. After a productive initial phase focused on establishing methodologies and conducting preliminary investigations, our doctoral candidates are now producing tangible research results across multiple domains of noise and vibration engineering.

This transition into the project's second half brings with it a wealth of knowledge sharing, as evidenced by our researchers' extensive participation in prestigious international conferences. Our doctoral candidates have been actively disseminating their findings and exchanging ideas with peers from around the globe, reinforcing the project's commitment to scientific excellence and collaborative innovation.



Noise and Vibration Engineering

- **International Conference on Noise and Vibration Engineering** (Sept 2024, Belgium)*:*

  The conference is a biennial event on structural dynamics, modal testing and noise and vibration engineering, organized by the KU Leuven Department of Mechanical Engineering. During this conference, the several DCs candidates attended.

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- **ISNVH 2024 Green & Digital (Twin) Transition** (June 2024, Austria) *Researchers: Ludovica Luciano, Giovanni Pirro, Javier del Fresno*

  During this conference, the DCs candidates presented the objectives and scopes of the GAP_NOISE project, outlining their individual research activities and their contribution to the overall project framework.

Acoustics and Signal Processing

- **DAS|DAGA 2025** (March 2025, Denmark) *Researcher: Luyao Dong*

  In this conference, the candidate discussed her research on developing a computationally efficient virtual sensing framework for exterior vibroacoustics using a time-domain Finite Element Model with perfectly matched layers. The method emphasized improved efficiency and accuracy in modelling unbounded acoustic domains and the potential applications to large-scale vibroacoustic problems were briefly outlined.

Automotive Technology

- **JSAE Annual Congress** (May 2025, Japan) *Researcher: Francisco Ramiro Ulloa Herrera*

  This study presents a multiphysics simulation approach for permanent magnet synchronous motors (PMSMs) using Ansys and Matlab®/Simulink for co-simulation and control technique analysis. The methodology involves electromagnetic force analysis, accounting for harmonics induced by current controllers under various control algorithms. A PMSM for traction applications is designed using Ansys, and the control method is developed in Simulink. The co-simulation evaluates magnetic and electrical interactions under different operating conditions. This approach allows the use of the same motor drive control across platforms, reducing development time and offers insights into extending the analysis to include vibroacoustic performance for enhanced motor design.

- **Cenex Expo 2025** (Sept 2024, UK) *Researcher: Francisco Ramiro Ulloa Herrera*

  Nowadays, vectorial control is the most used type of control on current EVs in the market. However, big improvements are still needed to enhance efficiency and performance. IDIADA has develop a methodology to analyse actual control strategies used on the newest EVs in the market. This information can be later use to study and improve this tractions units by simulation means, using different power electronics architectures and control methodologies.

- **FISITA World Automotive Congress** (Sept 2023, Spain) *Researcher: Ludovica Luciano*

  The researcher presented her master's thesis work on internal combustion engine control and optimization using machine learning techniques. She also introduced her newly initiated research activity within the GAP_NOISE consortium, highlighting the continuity of her expertise in the context of the emerging electrification framework.

Electrical Engineering

- **IECON 2025 - IEEE Industrial Electronics Society** (Oct 2025, Spain) *Researcher: Mahmoud Khamis*

  For the researcher, his presence allowed him to share his work, exchange ideas, and connect with inspiring researchers and professionals from around the world. The paper presented "Impact of

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Discontinuous PWM Techniques on NVH Performance in IPMSMs," investigates how different modulation strategies influence both noise, vibration, and harshness (NVH) and drive system efficiency. The study contributes to optimizing NVH performance and efficiency over a wide speed range, offering valuable insights into achieving quieter and more efficient electric drive systems through advanced PWM control.

- **IEEE Conference on Power Electronics** (Sept 2025, Egypt) *Researcher: Mahmoud Khamis*

  The researcher presented the paper, "Effect of Various PWM Aspects on NVH Performance for PMSMs: Analysis & Improvement," which explores how PWM aspects influence noise, vibration, and harshness (NVH) behavior in permanent magnet synchronous machines, and proposes methods for improving NVH performance in high frequency ranges.

- **IEEE Symposium on Circuits and Systems** (May 2025, UK) *Researcher: Ludovica Luciano*

  The researcher presented her paper on a sliding mode-based filter for estimating the oscillation amplitude of non-stationary signals. This work contributes to her research objectives on online harmonic estimation for NVH analysis and control in automotive systems.

- **IEEE Workshop on Electrical Machines Design** (April 2025, Malta) *Researcher: Francisco Ramiro Ulloa Herrera*

  This paper presents the design of a speed regulator for an interior permanent magnet synchronous motor (IPMSM) in traction unit applications. The regulator functions as the outer loop of a cascaded control system, with the torque control loop implemented through look-up table (LUT)-based vector control specifically field oriented control (FOC). The derating of the LUT due to safety functionalities as well as the computational delay of the digital signal processor (DSP) are taken into consideration in real-time scenario. The electrical and mechanical parameters of the IPMSM are estimated following IEEE Std 1812 guidelines, ensuring accurate computation of the controller gains. Despite challenges posed by non-ideal hardware factors, such as voltage source inverter (VSI) nonlinearities and parameter saturation, simulation and hardware-in-the-loop (HIL) results demonstrate that the designed speed regulator effectively tracks its reference under four-quadrant operation. These findings validate the suitability of the proposed regulator for traction applications.

Structural Engineering

- **ICEDyn - Structural Engineering Dynamics** (June 2025, Portugal) *Researchers: Sara Tincani*

  A paper entitled "Enhancing NVH mitigation: a hybrid approach for locally resonant metamaterial design". As in the previous conference, the main topic was the use of Locally Resonant Metamaterials. In this case, resonators have been produced and validated on a simplified structure (a plate subjected to base excitation) and then a hybrid approach to predict the behaviour of a LRM solution when applied to a structure was presented.

- **IMAC - International Modal Analysis Conference** (Feb 2025, USA) *Researcher: Sara Tincani*

  A paper entitled "Metamaterial-Based Vibration Mitigation for Enhanced Reliability of an Automotive Inverter: A Numerical Study" was presented. The aim was to investigate through a simulation study, the effectivity of a locally resonant metamaterial (LRM) solution when applied to a Power Electronic

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Unit (PEU). Different solutions were firstly compared. After, it was shown that a reduced behaviour in vibration on the component was reached through this treatment.

As the project progresses through its second half, our doctoral candidates are translating their theoretical frameworks into practical applications. These research outputs are beginning to address key challenges in noise reduction, vibration control, and sustainable engineering solutions across multiple sectors.

We anticipate accelerated progress towards our project goals in the coming months, with completion of key experiments, publication of peer-reviewed articles, and preparation of comprehensive technical solutions.

If you want to be updated on the evolution of our Doctoral candidates and their automotive specialisation fields check our webpage and follow us on our social media channels:

https://gapnoise.eu/

https://twitter.com/GAP_NOISE

https://www.instagram.com/gap_noise/

https://www.linkedin.com/in/gapnoise-doctoral-network-41887926b/

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