NEWSLETTER

ISSUE 5 - DECEMBER 2025

Dear Reader,

We are pleased to present Issue 5 of the HERWINGT Newsletter.

The Hybrid Electric Regional Wing Integration Novel Green Technologies (HERWINGT) project stands at the forefront of aviation decarbonization. Its mission is to design an innovative wing tailored for future hybrid-electric regional aircraft and to develop advanced architectures, structures, and technologies that enable greater integration of electrical systems. These breakthrough solutions target a 50% reduction in fuel consumption at the aircraft level, compared to a 2020 State-of-the-Art (SoA) aircraft, through three key approaches:

- Innovative wing designs and advanced aerodynamics cut drag, reducing fuel burn by 15%.
- Lightweight structures and smart integration deliver a 20% weight reduction.
- Hybrid-electric readiness with H_2/battery systems and SAF-compatible fuel technologies.

This issue features the year's most impactful conference sessions and meetings, highlighting the project's progress.

Enjoy the read!

On behalf of the HERWINGT Project Coordinator

AIRBUS

Best of 2025

PCIM Europe

IAIAA Aviation Forum

ICCM24

SAMPE EUROPE

15th EASN International Conference

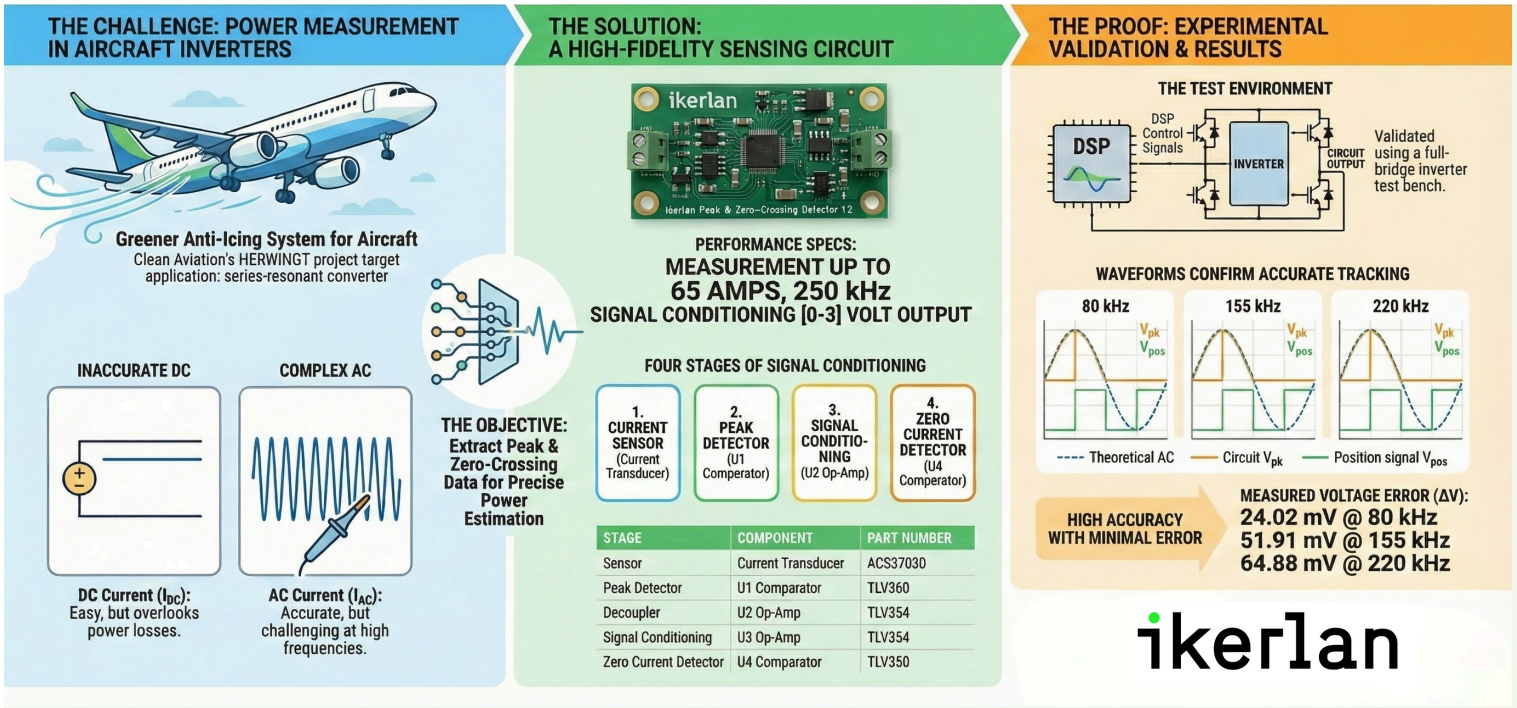
General Assembly

CLEAN AVIATION

Co-funded by the European Union

The project is supported by the Clean Aviation Joint Undertaking and its members. Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Clean Aviation Joint Undertaking. Neither the European Union nor Clean Aviation JU can be held responsible for them.

High-Frequency Current Sensing: A Novel Circuit for Greener Aviation



Accurate measurement for power converter in advanced aircraft anti-icing systems

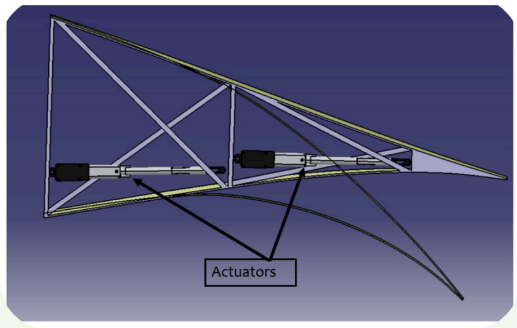
During the **PCIM Conference**, on May 6 - 8, 2025, at Nuremberg, Germany, **IKERLAN** presented pioneering research on **high-frequency current measurement circuits for series-resonant inverters**, **a key technology for wing-integrated ice protection systems** in hybrid-electric aircraft. This work introduces a novel signal conditioning circuit that accurately measures alternating currents at high frequencies, enabling efficient power control while reducing complexity and cost.

The paper introduces a signal conditioning circuit designed to measure high-frequency output currents in series-resonant inverters, a critical component for wing-integrated ice protection systems in hybrid-electric aircraft. Unlike conventional DC measurement methods, this approach enables accurate estimation of power by capturing both the peak value and phase shift of alternating currents, improving control precision and efficiency. The design includes stages for sensing, peak detection, signal conditioning, and zero-cross detection, with criteria for component selection and bandwidth optimization. Initial experimental validation confirms the circuit's performance across varying frequencies, marking a significant step toward reliable, cost-effective solutions for advanced electrical systems in sustainable aviation.

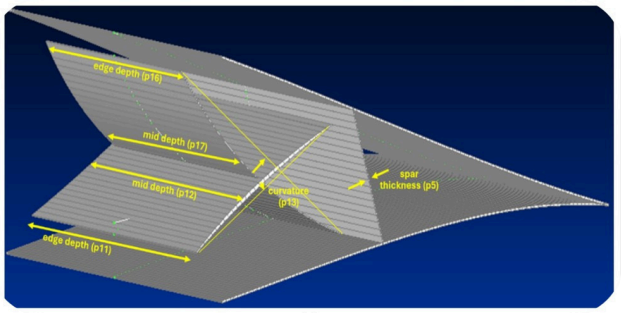
Evolution of the conceptual design of a full-scale compliant camber morphing flap for the next generation Hybrid Electrical Aircraft

At the AIAA Aviation Forum 2025, the Italian Aerospace Research Centre (CIRA), represented by **Maria Chiara Noviello**, presented groundbreaking work on the conceptual design evolution of a full-scale compliant camber morphing flap, developed within the HERWINGT project. This technology is designed for next-generation Hybrid-Electric Regional Aircraft (HERA), aiming to significantly reduce aerodynamic drag and fuel consumption while supporting sustainable aviation goals.

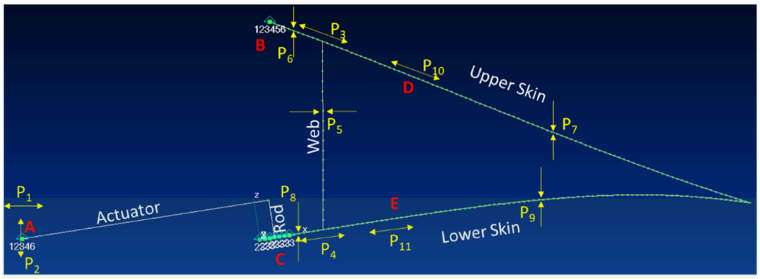
The study outlines the conceptual design evolution of three configurations—C1 (Truss-Rib), C2 (X-Rib), and C3 (Hybrid)—evaluated through advanced finite element analyses and optimization techniques. The final C3 configuration, integrating the best features of its predecessors, demonstrated superior performance in achieving target morphing shapes with reduced actuation forces, paving the way for advanced design and full-scale demonstration



Conceptual design C2: X-rib configuration, 1st version



Conceptual design C2: X-rib configuration, 2nd version

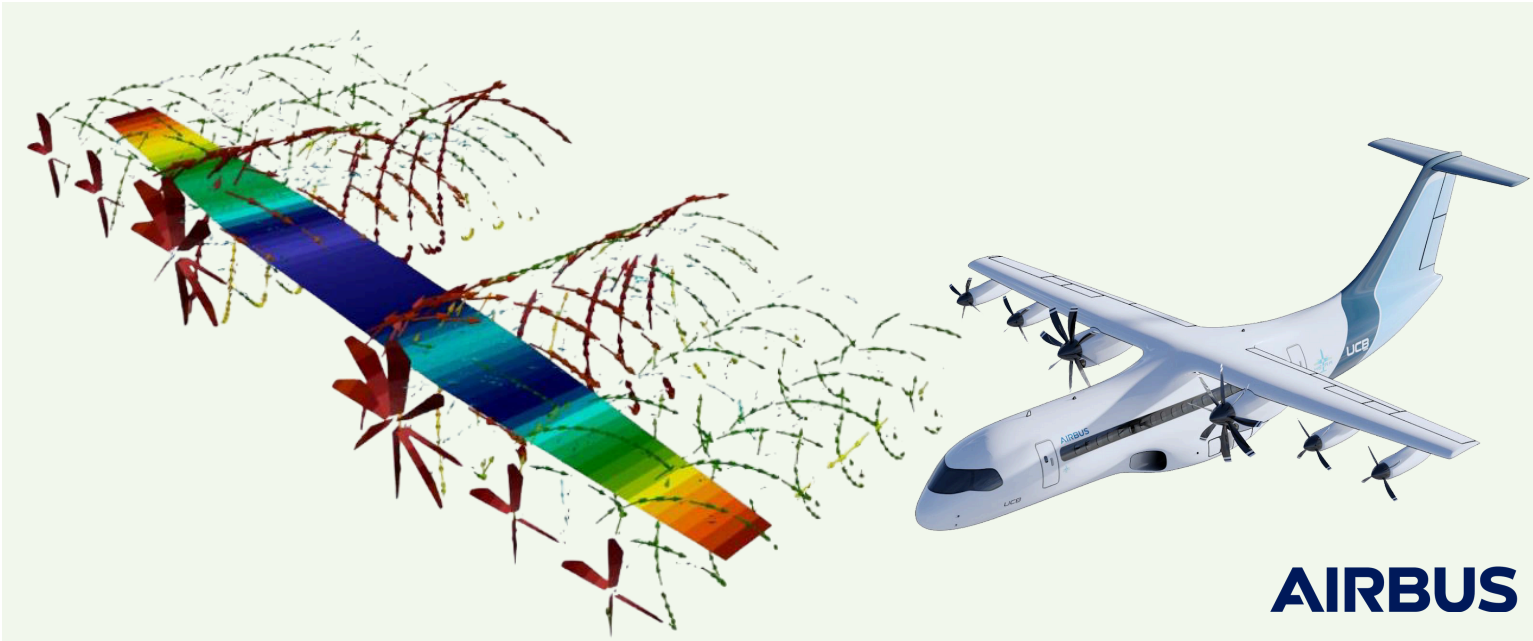


Conceptual design C3: Hybrid-rib configuration

By leveraging compliant architectures, genetic optimization, and cutting-edge simulation methods, this work represents a significant step toward adaptive wing technologies that enable smooth shape changes under aerodynamic loads.

Evolution of the conceptual design of a full-scale compliant camber morphing flap for the next generation Hybrid Electrical Aircraft

An AI-enhanced multidisciplinary optimization framework for net-zero transport aircraft



Multidisciplinary Design and Optimization (MDAO) framework for the HERWINGT wing

To achieve **50% fuel burn reduction** in regional aircraft compared to 2020 standards, a combination of advanced wing configurations, lightweight structures, and hybrid-electric technologies is required.

A key enabler of this transformation is an **AI-enhanced Multidisciplinary Design and Optimization (MDAO)** framework, developed to bridge the gap between academic research and industrial application. The framework introduces:

- Flexible system modeling using intuitive component-based structures.
- Automated coupling of disciplines for complex aircraft design.
- Integration with GEMSEO for uncertainty quantification and surrogate modeling.

At the **AIAA Aviation Forum 2025, Andrés Mateo-Gabín (AIRBUS)** presented the application of Generative AI techniques, including Denoising Diffusion Probabilistic Models, to optimize wing design parameters such as chord length, twist, and span. These advanced models delivered promising results, generating high-performing configurations that minimize wing and fuel mass while meeting aerodynamic targets. This integrated approach illustrates how AI-driven optimization can accelerate the development of next-generation Hybrid-Electric Regional Aircraft, reinforcing Europe's commitment to sustainable aviation.

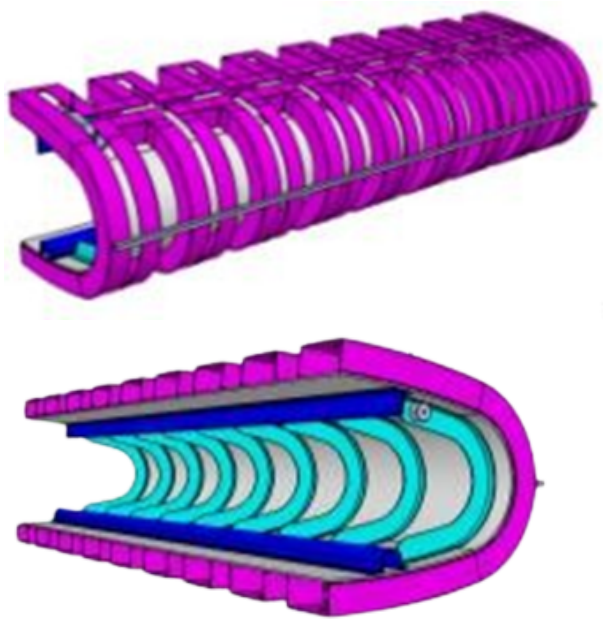
An AI-enhanced multidisciplinary optimization framework for net-zero transport aircraft

Sequential Resistance Welding of a Thermoplastic Composite Leading Edge Demonstrator: From laboratory testing to full-scale welding

Massimiliano Russello, Team Leader in Composite Welding Technologies at **AIMEN** Centro Tecnológico and member of the HERWINGT project team, presented his work at **ICCM24 – the 24th International Conference** on Composite Materials, held in Baltimore, Maryland, in August 2025.
With this work, a breakthrough in sustainable aeronautical manufacturing has been achieved. Transitioning from lab-scale innovation to industrial application, this work demonstrates how robotized, scalable, and eco-friendly welding technologies are shaping the next generation of aircraft wings.

The HERWINGT project has advanced highly integrated, robotized manufacturing technologies, scaling them from laboratory research to industrial application. Among these innovations, **Sequential Resistance Welding** stands out as a promising solution for joining thermoplastic composite structures. Its speed, reliability, and ease of integration make it ideal for next-generation wing components.

This research focused on welding a thermoplastic leading edge to internal ribs, investigating how parameters such as current, time, pressure, cooling, and material properties influence weld quality. Efforts included developing a carbon-based heating element for customized thermal patterns and a responsive control system capable of real-time adjustments.
Laboratory-scale trials using PEEK/CF composites involved process optimization, scale-up analysis, and rigorous characterization through microscopy and mechanical testing, paving the way for industrialization of eco-friendly welding processes.



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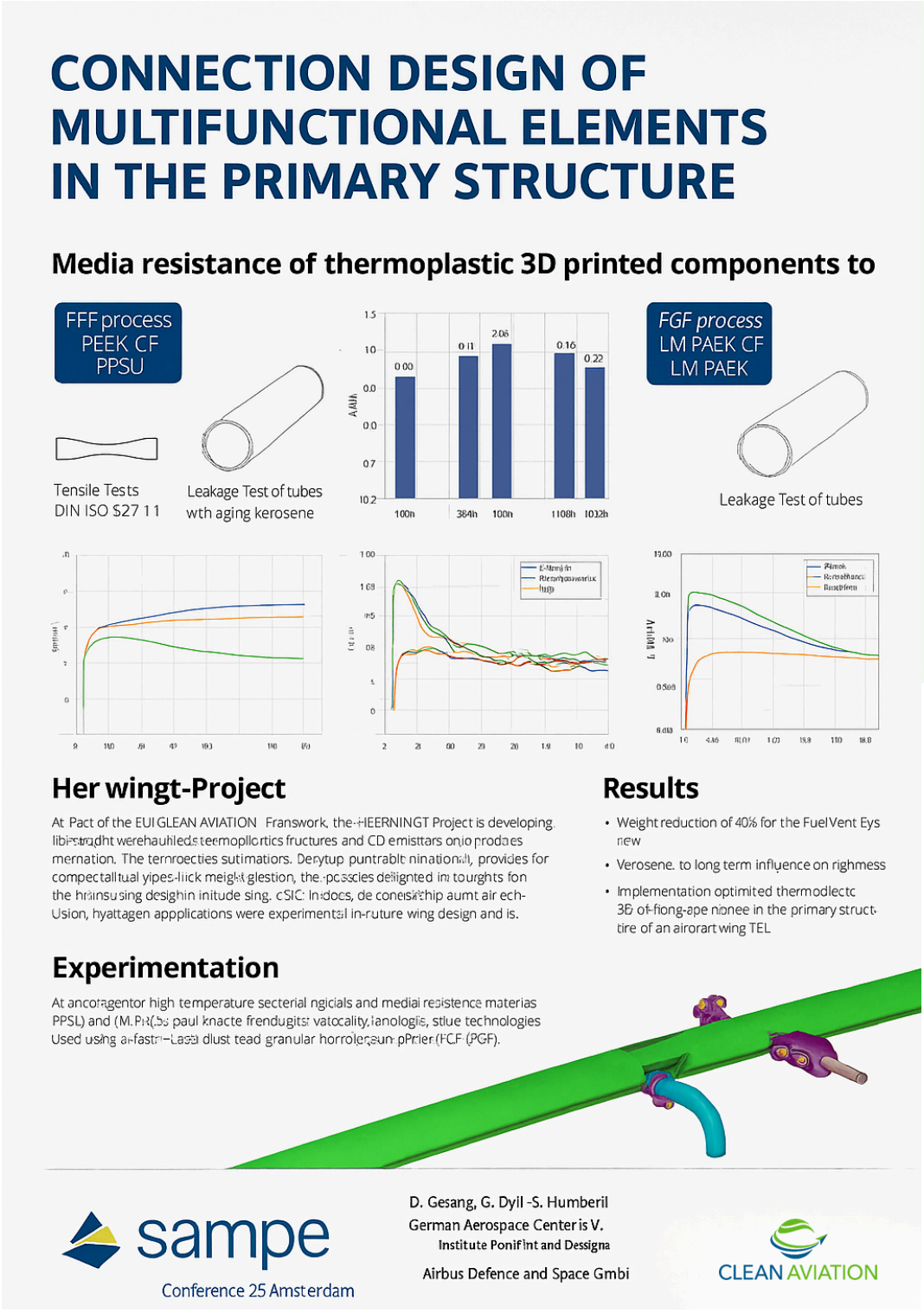
To become more familiar with this work, you can watch **Episode 5 (Season 1) of the HERWINGT video series.**

HERWINGT Video Series

Connection design of multifunctional elements in the primary structure



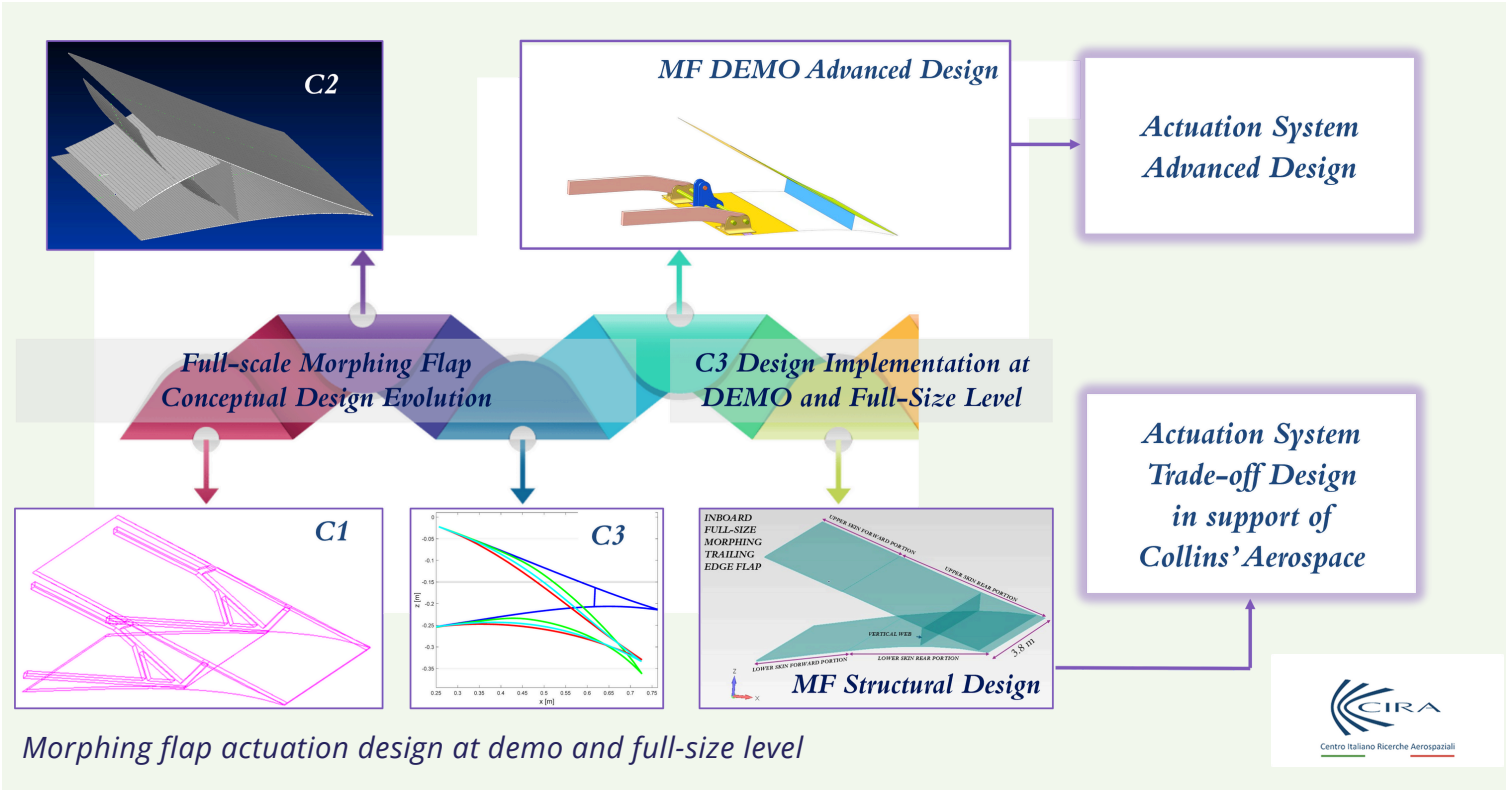
Georg Doll (DLR) has presented a poster **SAMPE Europe 2025,** showcasing innovative approaches to connection design of multifunctional elements in primary aircraft structures.

This research addresses a critical challenge in modern aeronautics: integrating advanced materials and technologies to achieve lighter, stronger, and more efficient wing components.

The work emphasizes the transition from conceptual design to practical application, focusing on solutions that enhance structural integrity while supporting sustainability goals.

By leveraging advanced joining techniques and multifunctional concepts, these developments contribute to the broader vision of next-generation hybrid-electric regional aircraft, aligning with Europe's commitment to greener aviation

Actuation system design for a compliant morphing trailing edge flap at demonstrator and full-size level



Morphing flap actuation design at demo and full-size level

Maria Chiara Noviello (CIRA) presented the study "*Actuation System Design for a Compliant Morphing Trailing-Edge Flap at Demonstrator and Full-Size Level*" at the **15th EASN International Conference**. This work addressed a key enabler for achieving HERWINGT's objectives of reducing fuel consumption and emissions through the integration of advanced aerodynamic, structural, and systems technologies into a strut-braced, high-aspect-ratio wing. Central to this effort is the development of adaptive high-lift systems, such as morphing droop noses and trailing-edge devices, designed to optimize aerodynamic performance across all phases of flight.

Within this framework, **the Italian Aerospace Research Centre (CIRA)** leads the design and experimental validation of a compliant morphing trailing-edge flap, capable of continuous camber variation during take-off and landing. This effort includes the manufacturing and testing of a 0.5-meter-span demonstrator for structural and aerodynamic characterization, as well as the preliminary design of a full-scale 3.8-meter flap to support actuation sensitivity studies in collaboration with Collins Aerospace.

Through this integrated approach, HERWINGT advances state-of-the-art morphing technologies, reinforcing Europe's commitment to sustainable aviation and the Clean Aviation objectives of reducing drag and enhancing overall aircraft efficiency.

Actuation system design for a compliant morphing trailing edge flap at demonstrator and full-size level

Conference proceedings and journal publications

- *"AI-Based Generative Algorithms applied to the design of Blended Wing Body Aircraft,"* by **Marta A. Martín** and Andrés Mateo-Gabín (AIRBUS), **AIAA Aviation Forum**
- *"Aerodynamic Benefits of Camber Morphing Technology for Strut-Braced Wing Configurations,"* by **Ilias Tsatsas,** Emanuele Sticchi, Xavier Carrillo Córcoles, Roeland De Breuker, and Jurij Sodja (TUD), **AIAA SCITECH 2025 Forum**
- *"HERWINGT project overview GKN Aerospace – Sampe October 2025: Isothermal press-molding of rapid-cure prepregs for spars and TP in-situ co-consolidation for stiffened wing skins,"* by **Gijs J. Brouwer**, Salvador Romero Esteban, & Will Broom (GKN FOK), **SAMPE Europe**
- *"Design optimization and virtual testing of a morphing aileron with high actuation bandwidth,"* by Vittorio Cavalieri and **Alessandro De Gaspari** (POLIMI), **Aerospace Science and Technology**
- "Preliminary Design of Advanced Wing for an Ultra Efficient Regional Aircraft," by **Giovanni Marco CAROSSA** and Francesco TOFFOL, **AIDAA-CEAS**
- *"Towards the development of bird strike simulation models for Hybrid Electric Regional Aircraft wing structures,"* by **Lampeas George**, Tsiourva Theodora, Diamantakos Ioannis, & Roumelioti Vasiliki (UPAT), **AIDAA-CEAS**
- "*Aerodynamic Installation Effects on Propeller-Driven Strut-Braced Wing Aircraft in High Lift Conditions*," by **E. Sticchi** and D. Ragni (TUD), & D. Casalino, **Journal of Aircraft (AIAA)**
- *"Design and Experimental Integration of a Compliant Morphing Flap Demonstrator for Hybrid-Electric Aircraft,"* by Maria-Chiara Noviello (CIRA) et al, **MDPI Biomimetics**

HERWINGT'S general assembly in Vienna: Road to Completion is set!

HERWINGT partners at the RTA premises, in Vienna, Austria.

During the **General Assembly** in Vienna, the HERWINGT consortium reaffirmed its commitment to advancing the project with determination and focus. Building on the outcomes of the meeting, partners are driving progress through strategic vision, operational excellence, and strong collaboration.

The discussions highlighted key priorities, including aligning innovation with long-term growth objectives, identifying emerging market opportunities, and implementing practical steps to enhance efficiency and impact.

With dedication and collective effort, the consortium is confidently approaching the project's final milestones, ensuring impactful contributions to sustainable aviation

HERWINGT

A pioneering wing design for a future hybrid-electric aircraft

AIRBUS

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