STS08

EU-Funded Research and Innovation on Computational Methods towards Climate Neutrality of Aviation

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Europe's Vision for Aviation "Flightpath 2020" and the European Green Deal have set ambitious goals for the aviation sector, so that it reaches climate neutrality. The aviation industry is thus faced with multiple challenges, including the need for a sustainable recovery in the aftermath of the global pandemic. The aforementioned challenges also give rise to opportunities for the development of disruptive technologies, which will accelerate the decarbonisation of aviation. To this end, advanced numerical tools and digitalisation are key to facilitating the testing, certification and deployment of these game-changing technologies and thus minimizing aviation's environmental impact.

Evidently, innovative computational methods can be critical to help reducing emissions in all areas of aviation and in all phases of the aircraft lifecycle. These include multi-fidelity modelling and multi-disciplinary computational tools (for fluid dynamics, aerodynamics, aero-acoustics, combustion, emissions, and climate impact among others), robust design and optimization processes, advanced structure mechanics and composite material manufacturing technologies. Such methods also leverage on recent advances in data-driven tools and Artificial Intelligence (AI), as well as on the constantly increasing capabilities of highly-parallel computing.

The cutting edge research and innovation (R&I) funded by the Horizon 2020 programme has contributed significantly to the aforementioned high level objectives of the "Flightpath 2020" vision and the European Green Deal. In this context, within the ECCOMAS Congress 2022, the European Commission and its European Climate, Infrastructure and Environment Executive Agency (CINEA) are organising a dedicated Special Technology Session (STS) on the development and application of advanced computational methods for modelling, simulation, optimization and validation of technologies contributing towards climate neutral aviation. The theme of this STS includes applications such as disruptive aircraft architectures and composite structures, novel propulsion systems and technologies, and supersonic aircraft concepts.

The objective is to present an overview and examples of EU-funded research and innovation, to show the main progress achieved, to identify gaps between the needs and the current state of the art, and to gather research recommendations on short, medium, and long-term challenges.

List of session papers and authors:

Part 1: EU-Research for an Environmentally Friendly Aviation

Contributions of EU-funded projects managed by CINEA towards climate neutrality of aviation
Leonidas Siozos-Rousoulis, European Climate, Infrastructure and Environment Executive Agency (CINEA);

Aero-acoustic installation effects in disruptive aircraft architectures
C. Schram, A. Zarri, J. Christophe, VKI - Von-Karman Inst. for Fluid Dynamics and H. Bériot, Siemens Industry Software;

Aero-acoustic analysis of a landing-gear configuration for noise reduction using porous fairings in the INVENTOR project
P.A. Koutsoukos, D. Ragni, F. Avallone, TU Delft

Uncertainty quantification of composite structures with manufacturing defects within the SuCoHS Project
B. Kriegesmann, G. Balokas, Hamburg University of Technology and T. Will, DLR - German Aerospace Center

Part 2: Research for a Sustainable Supersonic Civil Transport

SENECA project: Climate effects assessment of supersonic aviation
E. Terrenoire, ONERA, Univ. Paris Saclay, S. Matthes, R. N. Thor, DLR, D. S. Lee, R. Rodriguez de Leon, L. Lim, B. Owen, A. Skowron, Manchester Metropolitan University, P. Leyland, AEDS, D. Marsh, Eurocontrol and K. Synylo, National Aviation Univ. Ukraine

The role of computational methods for a multi-fidelity aerodynamic characterization of supersonic aircraft
M. Marini, P. Roncioni, CIRA, S. Hernandez, F. Nieto, Univ.of A Coruña, D. Ferretto, O. Gori, Politecnico di Torino, G. Stoican, D. Pepelea, V. Pricop, INCAS, B. Saracoglu, G. Grossir, B. O. Cakir, VKI and M. Clay, Reaction Engines;

Reduced order computational methods for the development of the propulsive technologies for supersonic aviation to achieve climate neutrality
A. C. Ispir, B. O. Cakir, K. Van den Borre, F. Civerra, A. Tognelli, B. H. Saracoglu, VKI - Von Karman Institute for Fluid Dynamics;

The role of computational methods to predict pollutant and GHG emissions from future supersonic civil aircraft using biofuels or H_2
C. Fureby, A. Åkerblom, T. Nilsson, Lund Univ., Dept. of Energy Sciences, M. Passad, E. Nilsson, Lund Univ., Dept. of Physics, G. Saccone, CIRA, B. Saracoglu, VKI, N. Viola and R. Fusaro, Politecnico di Torino