

Aerospace Europe Conference 2023

Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX (to be filled by the organizers)

Preferred Topics: SUSTAV / UAVFUT / AEROFLYPHY (3 maximum from the list of topics)

Corresponding author: Luis Miguel GARCÍA-CUEVAS

e-mail of corresponding author: luiga12@mot.upv.es

Type: Oral

Status of corresponding author: Regular

For student corresponding author: student member of one of the following:

3AF / AAAR / AIAE / AIDAA / CzAeS / DGLR / FTF / NVvL / PSAA / RAeS / SVFW / EUROAVIA

Title

Design of unmanned air vehicles with distributed electric propulsion: range improvement and noise emission

Authors

Luis Miguel GARCÍA-CUEVAS ^{1*}, Jorge GARCÍA-TÍSCAR ², Pau VARELA ³, Federico Nahuel RAMÍREZ ⁴

* Corresponding author

¹ CMT–Motores Térmicos, Universitat Politècnica de València, 46022 Valencia, Spain, luiga12@mot.upv.es

² CMT–Motores Térmicos, Universitat Politècnica de València, 46022 Valencia, Spain, jorgarti@mot.upv.es

³ CMT–Motores Térmicos, Universitat Politècnica de València, 46022 Valencia, Spain, pavamar@mot.upv.es

⁴ CMT–Motores Térmicos, Universitat Politècnica de València, 46022 Valencia, Spain, fera1@mot.upv.es

Abstract

Due to the wide range of Unmanned Aerial Vehicles (UAVs) applications, the current fleet will multiply in the coming years [1]. However, this growth in the UAV fleet will inevitably be accompanied by a series of concerns. Mainly, the scientific community [2] is concerned about both polluting and greenhouse gas emissions, as well as noise emissions in the operation of these aircraft in urban environments [3]. In recent years, multiple technologies have been proposed to alleviate these problems, such as electrification or hybridization [4], use of distributed electric propulsion (DEP) [5], or boundary layer ingestion (BLI) [6]. Recently, in the research by Tiseira et al. [7], the combination of these technologies has been presented to design small fixed-wing aircraft weighing up to 25 kg. Those designs achieve up to 16% fuel savings compared to classic configurations based on ICE-powered mono propellers. This reduction in fuel for the same mission opens the door to designing new aircraft that optimise the application of these technologies, thus improving the associated pollution and noise. The effect in fuel consumption can also be directly translated into other powerplant configurations, such as fuel cell-battery hybrids or direct battery powered aircraft. In this work, a least absolute shrinkage and selection operator (lasso) method is employed with an aircraft design database to develop tools that can aid the DEP BLI aircraft conceptual and preliminary design. Although the objective of the design procedures is to minimise the energy consumption, the final configuration impacts the acoustic signature of the aircraft, which is an important concern during missions such as urban flight or patrol operations. Thus, the impact on noise emissions is also studied.

References

- [1] McKinsey & Company for EASA, “Study on the societal acceptance of Urban Air Mobility in Europe,” 2021.
- [2] C. L. Nickol and W. J. Haller, “Assessment of the performance potential of advanced subsonic transport concepts for NASA’s environmentally responsible aviation project,” 54th AIAA Aerosp. Sci. Meet., vol. 0, no. January 2016, pp. 1–21, 2016.
- [3] S. F. Quadcopter and T. Martinez, “Psychoacoustic characterisation of a small fixed-pitch quadcopter. ” In INTER-NOISE and NOISE-CON Congress and Conference Proceedings (Vol. 259, No. 8), 2019.
- [4] C. Kim, E. Namgoong, S. Lee, T. Kim, and H. Kim, “Fuel economy optimization for parallel hybrid vehicles with CVT,” SAE Tech. Pap., no. 724, 1999.
- [5] K. R. Moore and A. Ning, “Distributed electric propulsion effects on traditional aircraft through multidisciplinary optimization,” AIAA/ASCE/AHS/ASC Conf. 2018, no. 210049, 2018.
- [6] M. Elsalamony and L. Teperin, “2D Numerical Investigation of Boundary Layer Ingestion Propulsor on Airfoil,” 7th Eur. Conf. Aeronaut. Sp. Sci., pp. 1–11, 2017.

- [7] A. O. Tiseira Izaguirre, L. M. García-Cuevas González, P. Quintero Igeño, and P. Varela Martínez, “Series-hybridisation, distributed electric propulsion and boundary layer ingestion in long-endurance, small remotely piloted aircraft: Fuel consumption improvements,” *Aerosp. Sci. Technol.*, vol. 120, p. 107227, 2022.