Guest editorial: Innovative approaches in aviation: trends and challenges

International Symposium on Unmanned Systems: AI, Design and Efficiency (ISUDEF'24), International Symposium on Electric Aviation and Autonomous Systems (ISEAS'24), International Symposium on Aircraft Technology, MRO & Operations (ISATECH'24) and International Symposium on Sustainable Aviation (ISSA'24) were held in an Online/Hybrid Mode on May 22–24, July 29 to August 2, August 27–29 and October 30 to November 1, respectively.

Symposia, international in scope and multidisciplinary in nature, have been conceived as platforms to bring together researchers, engineers, policymakers and practitioners to engage in discussions on the most pressing challenges and emerging opportunities in aerospace science and engineering. Their thematic coverage extends broadly across the sector, emphasizing both fundamental research and applied technological advancements. Topics welcomed across these symposia include advanced materials and multifunctional structures for aerospace applications, the integration of renewable energy systems into aviation and the role of acoustics, vibration and noise reduction in shaping safer and more sustainable flight. Equally central are the areas of aeronautical and aerospace engineering fundamentals, air traffic management, airport operations and the evolving landscape of safety regulation and policy. The symposia further seek to highlight the transformative role of artificial intelligence and machine learning in aerospace applications, ranging from atmospheric and space flight mechanics to the automatic control of advanced vehicles and avionics. Clean aviation initiatives, electrified aircraft design, digital twin technology and novel computational methods such as high-fidelity computational fluid dynamics and optimization strategies also receive particular attention. In addition, these forums provide opportunities to explore research on emerging sustainable fuels, life cycle assessment methodologies and design approaches that embed sustainability from the earliest conceptual stages of aerospace systems development.

Attention is also devoted to the experimental and computational investigation of aerodynamics, propeller and rotorcraft aerodynamics and propulsion system innovations, as well as to fatigue, fracture mechanics and structural health monitoring. Contributions addressing novel manufacturing techniques, heat transfer processes, power generation and storage and energy-efficient engineering practices are strongly encouraged. Furthermore, the symposia recognize the importance of promoting diversity in aerospace engineering education and professional practice, while also considering the societal and policy implications of aerospace technology.

By encompassing such a wide spectrum of topics – including unmanned aerial and space vehicles, environmental issues and climate change, fleet-level planning and the optimization of maintenance, repair and overhaul – the symposia underscore their commitment to advancing a holistic and integrative vision of aerospace research. Ultimately, they aim to foster dialogue that not only advances technical frontiers but also informs policy, addresses environmental imperatives and ensures that aerospace systems of the future are efficient, resilient, inclusive and sustainable.

This special issue presents a carefully curated collection of papers, selected through a rigorous review process. The contributions represent both the most significant research presented at leading symposia and additional submissions from distinguished authors, offering readers a comprehensive perspective on current advances in the field.

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