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Editorial

Metascience in Aerospace - bridging the gap between theory, application, and innovation

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Dear Editorial Board Members and Readers:

With great pride and enthusiasm, we reflect on the successful inaugural year of Metascience in Aerospace, a journal created to answer the growing demand for a publication that bridges applied mathematics, theoretical physics, and aerospace science. Aerospace research and development require collaboration across fluid dynamics, materials science, control systems, and artificial intelligence. Metascience in Aerospace emphasizes the synergy of diverse disciplines and fosters the coupling of mathematical models and physical theories, experiments, and simulations to formulate holistic methodologies for solving real-world aerospace-related problems. With a mission to serve the aerospace community, we aim to publish high-quality peer-reviewed research outcomes that provide new insights into the fundamentals and applications of aerospace science.

From the earliest days of aviation to the advent of commercial space exploration, aeronautical and astronautical engineering have historically driven innovation through profound mathematical theories and rigorous physical models. Alongside traditional experiments and flight tests, modern aerospace research increasingly relies on computational tools, data-driven approaches, and machine learning processes. The first volume of Metascience in Aerospace highlights a strong focus on cross-disciplinary research on key challenges in aerospace science. The four issues comprising 19

outstanding papers in Volume 1 have explored various topics, including fluid dynamics, combustion, numerical methodologies, experimental data processing, and AI-integrated solutions. Several researchers have provided deep insights into physical phenomena such as mixing and vortex-induced vibrations, which advanced our understanding of the mechanisms that govern aerospace systems and underpin improved designs and performance. A noticeable number of applied research and technological innovations featured simulation and witnessed the prominence of mathematical models and numerical tools. Studies on laminar diffusion flame over liquid fuel beds at microgravity and wake transition mechanism depending on the angle of attack have highlighted the growing importance of computational approaches in efficiently and accurately analyzing complex hydrodynamic and aerodynamic systems. Other contributions have demonstrated how research actuates tangible improvements in aerospace technology, such as evaluating integrated strategies for satellite launch navigation and optimizing aircraft trajectory planning against wildlife strikes.

While maintaining the coverage of fundamental physical studies, advanced mathematical modeling, and innovative technological applications, we encourage courageous responses to those emerging trends. As the industry embraces data-driven methods, we receive articles dedicated to refining experimental data processing and data analysis; specifically, formulating practical rules for aircraft parameter identification, constructing efficient algorithms for outlier cleansing, and promoting refined methods for trend detection. As artificial intelligence transforms craft designs and route planning, several researchers have explored the transformative potential of AI-driven solutions for aerospace innovation, such as machine learning-based surrogates, to enable vehicle performance prediction and algorithms to improve sea ice detection accuracy. As the community focuses on technological sustainability and environmental impact, pressing concerns have been implied for a sustainable future in aviation and space exploration, as evidenced in a comprehensive assessment of air pollutant and noise emissions at airports and a numerical study on bladeless wind turbines as renewable energy harvesters.

The diversity of themes covered in the first volume of Metascience in Aerospace reflects the commitment to fostering interdisciplinary research that is both rigorous and relevant. This breadth also underscores the abundant opportunities in aerospace science. Looking ahead, Metascience in Aerospace will further strengthen its unique role as a platform for ground-breaking research that bridges theoretical conceptualization and technological implementation Moreover, it will seek revolutionary ideas in methodology and sustainability, like high-fidelity simulations to the level of digital twins, machine learning in decision-making capabilities, and higher fuel efficiency. Relevant research will be critical in determining the sustainable development of aviation and space exploration.

The launch of Metascience in Aerospace represents a significant milestone for the international aerospace community. We owe our initial fortune to the authors' innovation, the reviewers' dedication, and the editorial team's commitment. Additional appreciation goes to the support from our audience and the engagement of the broader aerospace community. We expect more researchers to contribute their insights, share their discoveries, and join us in advancing aerospace science and technology. Together, let us shape the future of aerospace science, pushing the boundaries of knowledge and technology to new heights.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The authors declare no conflict of interest.

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