Digital Engineering and Digital Twin

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EDITORIAL

Introduction to the Journal of Digital Engineering and Digital Twin

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Digital engineering is an integrated digital approach that uses authoritative sources of system models and data as a continuum across disciplines to support lifecycle activities from concept through disposal, which was first proposed in the Digital Engineering Strategy announced by the U.S. DoD in 2018. Digital engineering emphasizes the continuity of the use of models across stages of design, development, manufacture, acquisition, operation and maintenance in a more agile and informed manner. It will enable the system engineering to move from a design-build-test-fix paradigm to a model-centric paradigm. Nowadays, a growing number of engineering sectors and commercial enterprises are also embracing the digital engineering paradigm.

Digital Twin is an integrated multiphysics, multiscale, probabilistic simulation of an as-built product or system that uses the available physical models, sensor information, operation history, etc., to mirror and predict the behavior/performance of its corresponding physical product, which is at the center of the digital engineering paradigm. At the beginning of its introduction by NASA and the USAF in 2010, the digital twin was mainly for the operation and maintenance of aircraft. As more engineering sectors became involved, the idea of digital twin has been adopted for various products, such as turbines, ships, automobiles, bridges, etc, with applications spanning the entire lifecycle. Besides engineering, digital twins are also being explored and utilized in other fields such as individualized healthcare, smart city, digital transformation of organizations, etc., driving innovations and promoting smarter developments.

Digital engineering and digital twins have been a fast-growing field in recent years, which is demonstrated by the increasing number of related publications. According to the Web of Science, there were 1870 publications in 2021 and 2328 in 2022, accounting for more than 66% of all the publications (6329) in the field of DEDT in the past 10 years. These publications are mostly relevant to engineering and computer science, which also fall into various subfields such as automation, control, telecommunication, instrumentation, energy, robotics, etc. Since most of these publications are scattered among various journals in different fields, there is a high demand for a single journal dedicated to publishing key technologies and applications of digital engineering and digital twin.

In light of this, we decide to launch *Digital Engineering and Digital Twin*, an international peer-reviewed journal that covers a broad range of topics in the frontier of digital engineering and digital twin to be of interest and use to both academics and practitioners. The journal communicates original contributions primarily in the form of research articles, but also through letters, technical notes, review

articles, and editorials. The multidisciplinary nature of the journal is intended to encourage a fruitful exchange of ideas and research outcomes among different engineering specialties.

The journal's scope spans methods, technologies, and applications of digital engineering and digital twin in different stages of the product's lifecycle, including design, development, verification, manufacture, acquisition, operation, and maintenance, in a variety of engineering fields such as aerospace, automotive, marine, civil, mechanical, electrical, etc. Integrations and interactions of multi-stage and multi-disciplinary activities, including but not limited to multidisciplinary design analysis and optimization, model-based system engineering, virtual testing, rapid prototype, digital manufacture and assembly, self-awareness and self-control, prognostics and health management, are encouraged. Relevant methods for DEDT, such as physics-based modeling, data-driven modeling, model reduction, model calibration and updating, model adaptation, verification and validation, multi-domain modeling, multi-fidelity modeling, multi-disciplinary simulation, multi-level and multi-scale simulation, model/data fusion, uncertainty quantification, diagnosis and prognosis, risk-based decision-making, and predictive control, are welcomed. Key enabling technologies for DEDT including software development, platform deployment, connection and communication, visualization, as well as other relevant technologies such as the Internet of Things, cloud/edge computing, big data, artificial intelligence, and VR/AR, are also within the scope of DEDT and are welcomed.

These points constitute what *Digital Engineering and Digital Twin* will be focusing on. We encourage authors to submit their original work in the broad spectrum of DEDT to this new journal. With the belief that the world and various industries are through a rapid digital transformation process, we are pleased that this new journal of *Digital Engineering and Digital Twin* will be accompanying this transformation process to simulate, predict, and pilot this highly digital future world.