

2040 Vision Study: NASA's TTT Implementation Activities

Steven M. Arnold¹

¹Multiscale and Multiphysics Modeling Branch, NASA Glenn Research Center, Cleveland, OH
44135

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Abstract

Over the last few decades, advances in high-performance computing, new materials characterization methods, and, more recently, an emphasis on integrated computational materials engineering (ICME) and additive manufacturing have been a catalyst for multiscale modeling and simulation-based design of materials and structures in the aerospace industry. As a result, NASA's Transformational Tools and Technology (TTT) Project sponsored a study (performed by a team led by Pratt & Whitney) to define the potential 25-year future state required for integrated multiscale modeling of materials and systems (e.g., load-bearing structures) to accelerate the pace and reduce the expense of innovation in future aerospace and aeronautical systems. This talk will briefly review the findings of this 2040 Vision study (e.g., the 2040 vision state; the required interdependent core technical work areas, Key Element (KE); associated critical gaps and actions to close those gaps; and major recommendations) and discuss NASA's TTT implementation activities, with special emphasis on recent accomplishments. The study, NASA CR 2018- 219771, envisions the development of a cyber-physical-social ecosystem comprised of experimentally verified and validated computational models, tools, and techniques, along with the associated digital tapestry, that marries two non-mutually exclusive paradigms – “design of the materials” (material scientist viewpoint) and “design with the materials” (structural analyst viewpoint) – into a concurrent transformational paradigm that impacts the entire supply chain to enable cost-effective, rapid, and revolutionary design of fit-for-purpose materials, components, and systems. Although the vision focused on aeronautics and space applications, it is believed that other engineering communities (e.g., automotive, biomedical, etc.) can benefit as well from the proposed framework with only minor modifications. Finally, it is TTT's hope and desire that this vision provides the strategic guidance to both public and private research and development decision makers to make the proposed 2040 vision state a reality and thereby provide a significant advancement in the United State's global competitiveness.