Abstract for ASTM ICAM 2020
November 17-20, 2020
Rosen Shingle Creek Hotel
Orlando, Florida

Next Generation Durability and Damage Tolerance to Support Certification of Flight Hardware

Edward H. Glaessgen
NASA Senior Technologist for Computational Materials
Langley Research Center, Hampton, VA

Richard W. Russell
NASA Technical Fellow for Materials
Kennedy Space Center, FL

Durability and Damage Tolerance (D&DT), as currently applied to flight hardware throughout the Agency, is based on continuum and similitude assumptions and does not consider local material properties, environments and responses. These limitations impact our ability to support certification of new component designs, material systems and manufacturing approaches. The primary concern in this Engineering R&A plan is related to the imminent proliferation of parts produced by additive manufacturing (AM). These parts are being advocated by NASA's suppliers for use on a myriad of flight hardware because of their design flexibility and cost advantages. AM provides opportunities to reduce part counts through complex geometry and reduce manufacturing costs of low volume parts. However, AM materials have some notable metallurgical and microstructural differences compared to traditionally fabricated materials.

One of the challenges for the acceptance of AM is the greater tendency for a deleterious defect state, most commonly in the form of porosity, to exist in AM parts. Though this defect state is typically reduced through a hot isostatic pressing (HIP) processing step, the structural performance risks associated with the remaining defects and HIP-healed features is not known. Potential fracture control issues that must be resolved stem from the real possibility that an unhealed defect or a closed defect with less than pristine strength remains at a fracture critical location after HIP. As a result, NASA and the entire aerospace community have been confronted with the need to develop a robust and relevant certification methodology to enable safe implementation of these components.

The present work is an important step toward positioning NASA to credibly respond to vendors' push to implement this new AM materials technology by improving our understanding of AM processing and performance and transitioning that research-based understanding to next-generation engineering capabilities.