Providing a Rigorous Benchmark Measurement Foundation for Modeling-Informed Qualification and Certification of Metal AM Components

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ABSTRACT

Additive manufacturing (AM) is a transformative set of technologies that are increasingly being used for aviation applications. However, persistent challenges regarding throughput, reproducibility, reliability, and properties of the printed parts seriously impact qualification and certification (Q&C) [1,2]. To reduce this bottleneck, a tightly focused collaboration of aviation OEMs, research and regulatory government agencies, and universities was established to develop a comprehensive strategy for broadly incorporating computational materials approaches into the aviation AM Q&C process. This group, called Computational Materials for Qualification and Certification (CM4QC), has spent nearly five years developing its 192-page strategy document that is scheduled for public release in the summer of 2025. CM4QC and its conclusions will be described. One critical aspect is model validation which will be discussed with reference to the NIST-led Additive Manufacturing Benchmark Series (AM Bench), which provides modelling challenge problems and rigorous measurement test data for validating AM simulations for a broad range of AM technologies and material systems [3]. AM Bench operates on a three-year cycle, and in summer of 2025 it completed nine broad sets of benchmark measurements with corresponding challenge problems for the AM modeling community. To learn more about AM Bench, along with its datasets, challenge problems, and corresponding conference series, please visit www.nist.gov/ambench.

REFERENCES

[1] L. Levine, B. Lane, E. Glaessgen, M. Gorelik, Providing a Rigorous Benchmark Measurement Foundation for Modeling-Informed Qualification and Certification of Metal Additive Manufactured Components, JOM (2024). https://doi.org/10.1007/s11837-024-06388-7

[2] E.H. Glaessgen, L.E. Levine, P.W. Witherell, M.A. Donmez, M. Gorelik, N.A. Ashmore, R.R. Barto, C.C. Battaile, H.R. Millwater, G.J. Nanni, A.D. Rollett, E.J. Schwalbach, V. Venkatesh, NASA / NIST / FAA Technical Interchange Meeting on Computational Materials Approaches for Qualification by Analysis for Aerospace Applications (2021). https://ntrs.nasa.gov/api/citations/20210015175/downloads/NASA-TM-20210015175%20Final.pdf

[3] L. Levine, B. Lane, C. Becker, et al., Outcomes and Conclusions from the 2022 AM Bench Measurements, Challenge Problems, Modeling Submissions, and Conference. Integr Mater Manuf Innov 13, 598–621 (2024). https://doi.org/10.1007/s40192-024-00372-4