Experiences With Materials Information Management Systems For ICME: Automated Analysis Of Materials Using Modelling To Iterate Materials Properties Within Known Boundaries

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ABSTRACT

Managing the relationships between process, structure, property and performance for structural materials and the components fabricated from them, provides a critical path for innovation in most materials systems[1]. Integrated Computational Materials Engineering (ICME) has the potential to enable both further innovation and efficiency gains by allowing deeper understanding and control to emerge – and to shift the focus of prediction beyond static property calculations to understanding the performance of materials as they are within manufactured structures and how they behave in service. This paper draws on the experiences the Materials Data Management Consortium (MDMC), a group of leading engineering enterprises (including Airbus, Boeing, GE, Honeywell, Lockheed Martin, NASA, P&W, RR and Sulzer) to collaborate on best practice approaches for managing critical materials data[2], with a focus on providing tools and traceable workflows for simulation and multi-scale modelling. The key development outlined in this paper concerns the automated generation, control and assimilation of "prediction data" within a materials information management system[3] in the same manner that test data and design allowables have historically been managed. NASA GRC's integrated multiscale micromechanics analysis code (ImMAC) software toolset was fully integrated within a materials information management system[4] to allow seamless simulation runs with automated capture of the appropriate results and meta data. This solution allows for the data from all relevant length scales, model information, and validation data to be integrated and shared across computational and empirical calculations, and are available in the right form at every stage of the engineering process. It is dependent upon data structures that are designed through the careful application of materials domain knowledge, supported by information technologies that allow them to be adapted and refined for ICME.

REFERENCES

[1] W. Marsden, D. Cebon and E. Cope, "*Managing Multi-Scale Material Data For Access Within ICME Environments*," Tools, Models, Databases, and Simulation Tools Developed and Needed to Realize the Vision of Integrated Computational Materials Engineering, S.M. Arnold and T. Wong (Eds.); ASM International, (Materials Park, OH, 2011).
[2] D. Cebon and M.F. Ashby, "*Engineering materials informatics*," MRS Bulletin, Vol. 31, No. 12, pp. 1004-1012, 2006.
[3] Arnold, S.M**.,** Holland, F. and Bednarcyk, B.A.; (2014). *Robust Informatics Infrastructure Required For ICME: Combining Virtual and Experimental Data*, 55th AIAA/ASMe/ASCE/AHS/SC Structures, Structural Dynamics, and Materials Conference, National Harbor, Maryland, 13 - 17 January 2014, AIAA-2014-0460.
[4] S. M. Arnold, F. A. Holland Jr, B. A. Bednarcyk and E. J. Pineda, "*Combining material and model pedigree is foundational to making ICME a reality*" (2015) 4:4 DOI 10.1186/s40192-015-0031-2