Developing a Robust 3D Representation Framework for 3D Printed Materials

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3D printing or Additive Manufacturing (AM) is, in principal, capable of producing objects with geometric features unobtainable via conventional manufacturing approaches with lead times sometimes significantly shorter. In the longer term, AM could be used to produce components with carefully modulated chemistries, microstructures, and properties for advance structural and functional designs, and possibly even blends of both. While these advances are promising, aerospace applications have stringent demands on performance and quality, and more widespread use of AM will require both an understanding of and the ability to manipulate processing – structure – properties relationships.

To this end, the AM community is engaged in a wide range of activities aimed at understanding these links for AM processes and materials. Approaches under consideration include analysis of pre-build process planning data, collection of in situ process execution monitoring streams, extensive post-build component characterization (both destructive and non-destructive), and a wide array of process modeling activities. All of these efforts produce copious quantities of 3D spatial data describing the process and the resulting material. Our research efforts are focused on developing a robust framework for representing and analyzing these data sets. This suite of tools, built within the DREAM.3D software, enables registration of disparate data types and importantly identification and analysis of correlations that enable physical understanding of processing – structure – properties links. These tools are directly applicable for analysis of existing processes enabling better understanding of material integrity and performance, as well as enabling future process improvements and modifications.