Uncertainty Quantification in Serial Section Techniques

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Abstract.

Serial sectioning techniques for the development of three dimensional microstructures are important to the advancement of material behavior modeling. Three dimensional microstructures provide valuable statistical information about the underlying structure and defects of a given material sample. However, due to their very nature the material sample is destroyed in the process, and serial sectioning methods often provide no quantitative measure of the accuracy to which they reduced a sample as a digital microstructure. Without such measures of accuracy, error propagates unaccountably to material modeling and simulation experiments. Furthermore, serial sectioning data sets are expensive in terms of time and resource allocation. User defined parameters such as resolution, slice thickness, dwell time, and polishing method all have a direct correlation to both the accuracy and experimental cost of a given serial sectioned data set. To address the issues of error propagation and experimental accuracy vs. experimental cost, a computational method was developed to simulate serial sectioning data collection. By starting with a digital representation of a material, and simulating serial sectioning data collection, final results can be compared directly to their original source. Thus, providing a quantifiable comparisons of accuracy for different serial sectioning methods. This helps to account for inerrant errors of reconstructed microstructures and inform experimentalist on best methods.