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MACHINE LEARNING AND SEQUENTIAL DESIGN WITH VARIABILITY

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Metal additive manufacturing (AM) has been the subject of active research in recent years. In laser powder bed AM, a laser beam with prescribed power and speed is scanned across metal powder. The melting and subsequent metal solidification results in complex microstructures which control the net properties of the AM part. Recent reports have shown considerable variability in the observable properties of the printed objects mainly due to AM process parameters and printing environment. The high level of variability in material properties of AM printed parts makes it crucial for engineers to take into account and apply uncertainty quantification methods in order to optimize AM process parameters and quantify the resultant properties. In this study, we propose a sequential sampling design to drive the search towards AM processing parameters that are expected to yield optimal mechanical properties. The novelty of the proposed approach lies in its use of machine learning tools to consider both variability in the measured properties and the uncertainty in the predictions to propose the next search site along with the required number of samples at each site. Experimentally obtained AM process-property data of 316L steel are used to showcase our approach. This study is expected to yield a methodology to efficiently navigate the AM process parameter space towards optimal materials propertie

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