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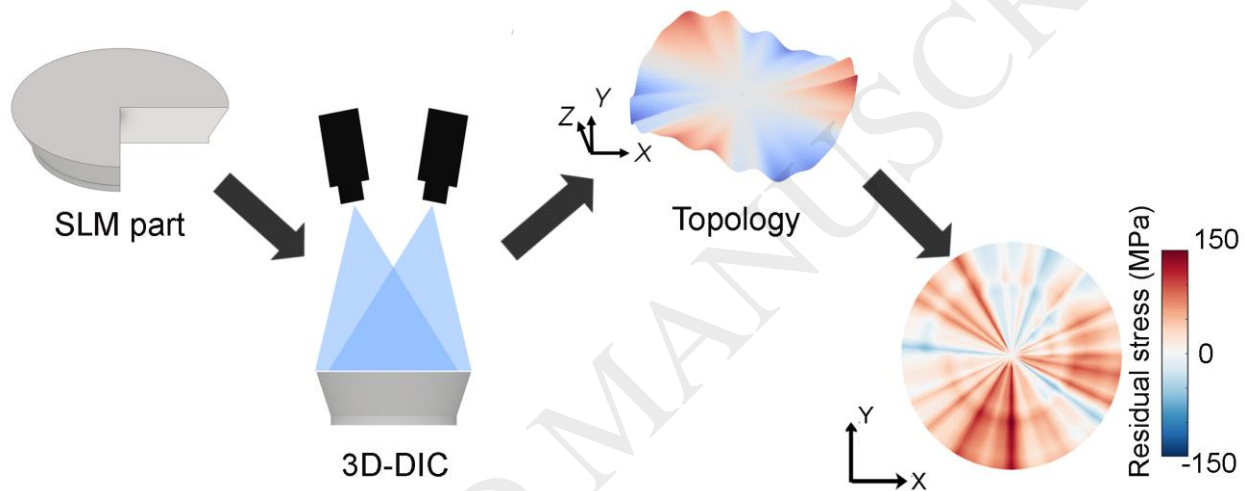
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Graphical abstract



Abstract

The severe thermal gradients associated with selective laser melting (SLM) additive manufacturing (AM) generate large residual stresses (RS) that geometrically distort and otherwise alter the performance of printed parts. Despite broad research interest in this field, it has remained challenging to measure warpage in general as well as RS distributions *in situ*, which has obfuscated the mechanisms of stress formation during the printing process. In pursuit of this goal, we have developed a *non-destructive* framework for RS measurement in SLM parts using three-dimensional digital image correlation (3D-DIC) to capture *in situ* surface distortion. A two-dimensional analytical model was developed to convert DIC surface curvature measurements to estimates of in-plane residual stresses. Experimental validation using stainless steel 316L “inverted-cone” parts demonstrated that residual stress varied across the surface of the printed part,

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