Identifying and Controlling Residual Stress in Parts Built Using Selective Laser Melting

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Selective Laser Melting (SLM) is an additive manufacturing technology that allows parts to be created from laser melting of metal powder, rather than traditional methods such a machining and milling to remove waste from a bulk material. It is because of the greater efficiencies presented with this new technology that additive manufacturing is considered to be at the forefront of the third industrial revolution [1].

Selective Laser Melting (SLM) works by laser melting of metal powder in a layerwise fashion, to form a complete part. SLM shows great promise to produce parts with unique geometry, minimal waste and short production times. While processing issues of balling, density and surface finish are gradually being improved, the issues of deformation and residual stress are major problems [2]. The presence of residual stress reduces the structural integrity of the part and increases the need for post processing [3]. For the SLM technology to be utilised, an understanding of the formation and control of residual stresses must be established. This work is being undertaken with the aim of being able to control and optimising the stresses through manipulation of input parameters. Experimental temperature profile logging and residual stress testing (using neutron and synchrotron diffraction) are used alongside Finite Element Modelling (FEM) to quantify, predict and control these stresses.

References:

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