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OPTIMIZATION OF TIME-VARIANT LASER POWER IN A CLADDING PROCESS

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ABSTRACT

Maintaining a constant molten pool temperature during an AM process often leads to more stable cooling rates, improving microstructural homogeneity and isotropy. A common approach to minimizing molten pool variation is the use of feedback process control; a thermal camera is used to monitor molten pool temperatures as the AM process is underway, and laser power is modified as necessary to minimize variation. This method, although effective, has a high barrier of entry: It requires expensive equipment and high skilled labor to set up and run. This work investigates the use of numerical optimization in minimizing molten pool temperature variation in an AM process. Although computationally involved, numerical optimization is accessible to nearly all researchers, and requires no specialized equipment. The optimization algorithm developed herein was found to reduce variation in molten pool temperatures significantly, although it was not as effective as a simulated feedback-controlled process. The algorithm can therefore allow manufacturers to attain improved results with little investment or change to their conventional AM processes. Experimental investigation is yet required to determine if the reduction in molten pool temperature variation attained by this algorithm will result in notable microstructural improvements in the printed part.