Intelligent Toolpath Planning and Control for Cold Spray Additive Manufacturing

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Cold spray technology has gained significant attention in the field of dimensional recovery for damaged parts and components due to its unique advantages, such as avoiding local melting, minimizing thermal stress, and achieving high Deposition efficiency. However, limited research has been conducted on optimizing nozzle trajectory and robot kinematics, which play a crucial role in determining disposition microstructure, disposition thickness, and disposition surface quality. To address this gap, this research proposes an intelligent toolpath planning and control system for cold spray additive manufacturing, integrating multi-axis tool path optimization and deposition modeling. The nozzle trajectory is strategically controlled to ensure that the surface to be deposited remains perpendicular to the work orientation, thus minimizing powder distortion on the workpiece surface. Additionally, the system considers the dynamics of the cold spray process and the relationships between process parameters and deposition characteristics during the process planning stage. By employing this comprehensive approach, the quality of the recovery of damaged components can be significantly improved, leading to enhanced deposition efficiency and cost reduction in machine component repair operations.