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Scanning strategy for grain size control in the multitrack laser metal deposition for additive manufacturing applications

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The comprehensive investigation of scanning strategies of the multitrack layers produced by laser metal deposition (LMD) with coaxial powder feeding is presented. The first two steps of the part additive production are optimized using a previously developed hydrodynamic model in search for low waviness and microstructure control. We verify the numerical model for the single-track LMD showing rather good correspondence. The main parameters of the scanning strategy i.e. scanning path, overlap ratio and idle time are optimized for additive manufacturing (AM) applications. We show that the optimal overlap ratio is dependent on processing parameters and multitrack investigation is needed for its estimation. A new method for optimizing layer growth parameters is proposed, which is in the adjusting of the geometry of a single track when the process conditions change instead of searching for new hatch spacing. Feasibility for modifying the average crystalline size and the preservation of the layer geometry and scanning strategy is presented both numerically and in experiments. The possibility of controlling the grain size of similar layers is another step for building parts with a defined quality.