Predictive Modeling for Multicomponent Additive Manufacturing **Using Convolutional LSTM Networks**

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RESEARCH OBJECTIVE

Multicomponent additive manufacturing (AM) has attracted increasing attention because fabricated alloys have phenomenal material properties. To understand the mechanism and validate numerical simulation, an experimental setup with two material components having a conjunct boundary were conducted. After the validation, numerical simulation with different parameters are prepared. Due to the high cost of computation and experimentation of AM, a convolutional Long short-term memory (LSTM) network is developed to build predictive surrogate models to speed up the computation.

METHODS & RESULTS Experimental validation Predictive modeling Numerical simulation Laser movement direction Laser beam u_2 u_{10} Flow pattern Powder bed Melt nool **Re-solidified part** Substrate Triangula Copper Powder u_0 u_1 u_2 u_3 u_{α} coarse mesh Aluminum plate ConvLSTM model structure Schematic of Multicomponent AM Fine and coarse mesh Substrate 1. Benchmark problem: decay turbulence Experimental setup 1.00 0.75 y position -2.8 1) 0.6 -3.0 -0.50 -3.2 --3.4 04 -3.6 -0.25 Mass fraction field Temperature field -3.8 -4.0 -0.00 -4.2 Prediction Ground truth -3.25 -3.00 -2.75 -2.50 Calculate temperature Solve Naiver-Stokes Update velocity and dependent material TED data for single track TED comparison pressure field equation 2. Multicomponent AM problem properties Temperature field Calculate mass 1.00 Solve mass fraction Update mass fraction 1.00 fraction in liquid and field equation solid phases 0.75 0.75 ĴĻ 0.50 0.50 Extract temperature Solve multiand liquid fraction component enthalpy Update enthalpy field 0.25 0.25 field equation 0.00 0.00 Ground truth Prediction NORTHWESTERN

Numerical simulation flowchart

Morphology profile: 400W + 0.025 m/s