Predictive Modeling for Multicomponent Additive Manufacturing Using Convolutional LSTM Networks

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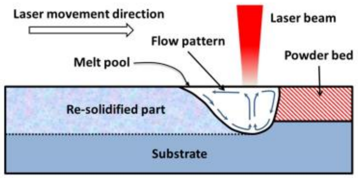
RESEARCH OBJECTIVE

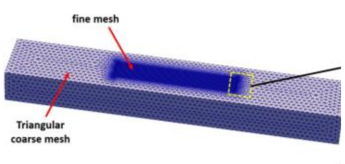
Multicomponent additive manufacturing (AM) has attracted increasing attention because fabricated alloys have phenomenal material properties. To understand the mechanism and validate numerical simulation, an experimental setup with two material components having a conjunct boundary were conducted. After 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

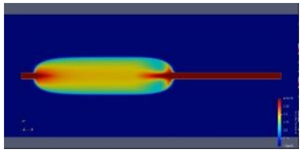
Numerical simulation



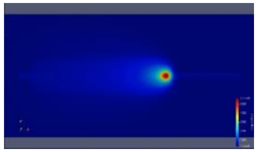
Schematic of Multicomponent AM



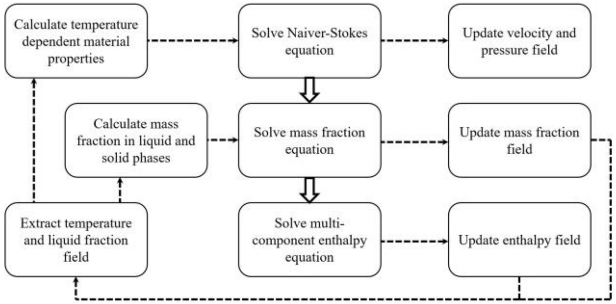
Fine and coarse mesh



Mass fraction field

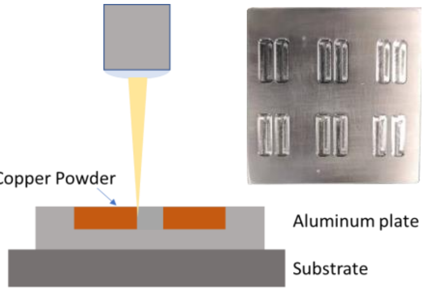


Temperature field

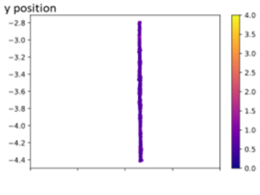


Numerical simulation flowchart

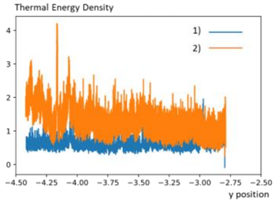
Experimental validation



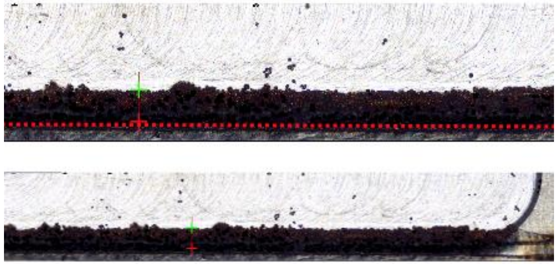
Experimental setup



TED data for single track

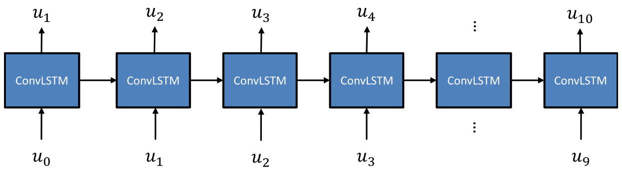


TED comparison



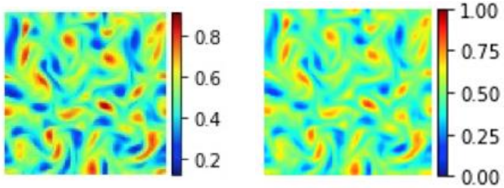
Morphology profile: 400W + 0.025 m/s

Predictive modeling



ConvLSTM model structure

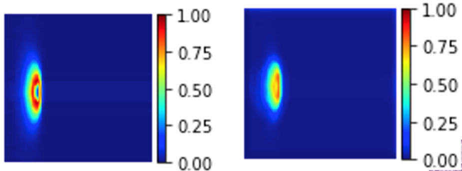
1. Benchmark problem: decay turbulence



Ground truth   Prediction

2. Multicomponent AM problem

Temperature field



Ground truth   Prediction

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