Motivation and Goals

- Computational Process and Material Modeling of Powder Bed additive manufacturing of IN 718
- Optimize material build parameters with reduced time and cost through modeling
- Increase understanding of build properties
- Increase reliability of builds
- Decrease time to adoption of process for critical hardware
- Potential to decrease post-build heat treatments

Approach

- Conduct single-track and coupon builds at various build parameters
- Record build parameter information and QM Meltpool data
- Refine Applied Optimization powder bed AM process model using data
- Report thermal modeling results
- Conduct metallography of build samples
- Calibrate STK models using metallography findings
- Run STK models using AO thermal profiles and report STK modeling results
- Validate modeling with additional build

Conclusions

- Photodiode Intensity measurements highly linear with power input
- Melt Pool Intensity highly correlated to Melt Pool Size
- Melt Pool size and intensity increase with power
- Applied Optimization will use data to develop powder bed additive manufacturing process model

Results

Data collected from the in-situ quality management module.

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MSFC track and coupon builds; AO and microstructure results - Image Credit: Kurt Makiewicz Master Thesis 2013

Future Work

- Examine weld bead geometry and provide data to AO
  - Image and record shape and geometry of weld “scallops”
  - Examine microstructure to understand evolution
    - Record grain shape, size, orientation, EBSD
    - Compare bottom and top layers
  - Measure and record micro-hardness over the height of the samples (build direction)
  - Evaluate samples for porosity, cracking (interdendritic, liquation), dendrite arm spacing, TEM, Microprobe, etc. as determined by team after initial results reported
  - Begin calibration and modeling of STK at OSU

Computational Process Modeling for Additive Manufacturing
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Dr. Wei Zhang

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