Deep Learning for Quality Prediction in Metal Additive Manufacturing

Matt Behnke
Mentor: Dr. (Grace) Guo

What is Laser Based Additive Manufacturing?

- Laser Based Additive Manufacturing (LBAM) is synonymous with layer manufacturing where products are made layer-by-layer
- LBAM can produce complicated parts with a wide breadth of engineering capabilities
- LBAM produces a melt pool from a laser
- The melt pool is used to produce the parts, layer-by-layer, and is also an integral part in determining the microstructure of the parts it creates
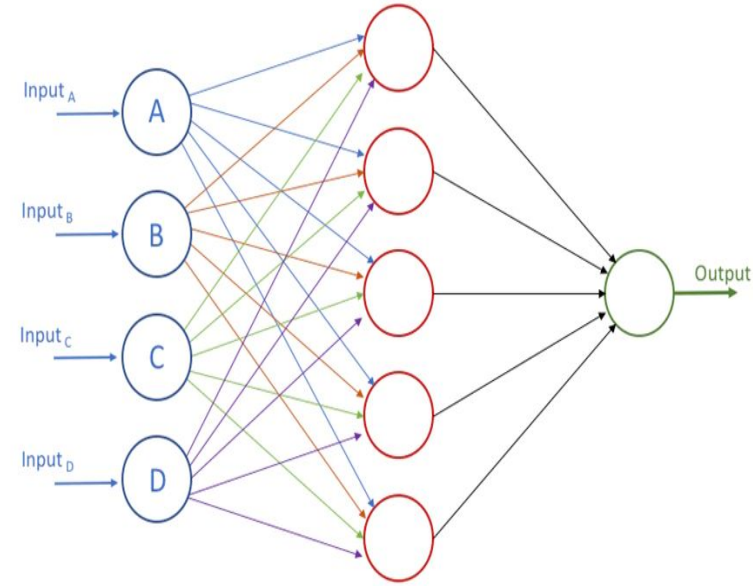
Problems in Additive Manufacturing

- A defect in LBAM is porosity, very small holes that occur in the surface
  - Occurs when the substrate is not fully melted/fused
- These defects can cause some structures to be unstable or adversely affect performance, this can be hard and expensive to detect

Current and Future Approaches

- Using physical and statistical models to predict when such defects would occur
    - Many complex mechanical models are used involved to make this type of detection, which increases cost
    - Not realistic for mass-production nor real-time quality control
- Use machine learning along with real time sensors to detect anomalies

What is Machine Learning?

- Machine Learning is a subset of Artificial Intelligence that uses data (typically quite a lot) with statistical algorithms to find patterns in data
- Neural Networks

Machine Learning + Additive Manufacturing

- Use data collected from pyrometer (measuring melt pool temperatures) and an Infrared (IR) Camera (measuring IR energy and mapping to produce a thermal visualization of the melt pool).
- From the data construct a reliable and accurate neural network that can predict defects during the LBAM process

Questions to Explore

- Possibilities of automatically cropping images in areas where defects are likely to occur
- How to incorporate an already existing physics knowledge into a machine learning model
- Finding what data is most valuable/influential in prediction of defects

Acknowledgements