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Machine Learning in Advanced Manufacturing
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Overview of talk

1. Introduction to Additive Manufacturing

2. Data
   - Pyrometer Data
   - Image Data

Why Additive?

"the process of joining materials to make objects from 3-D model data, usually layer upon layer, as opposed to subtractive manufacturing technologies"

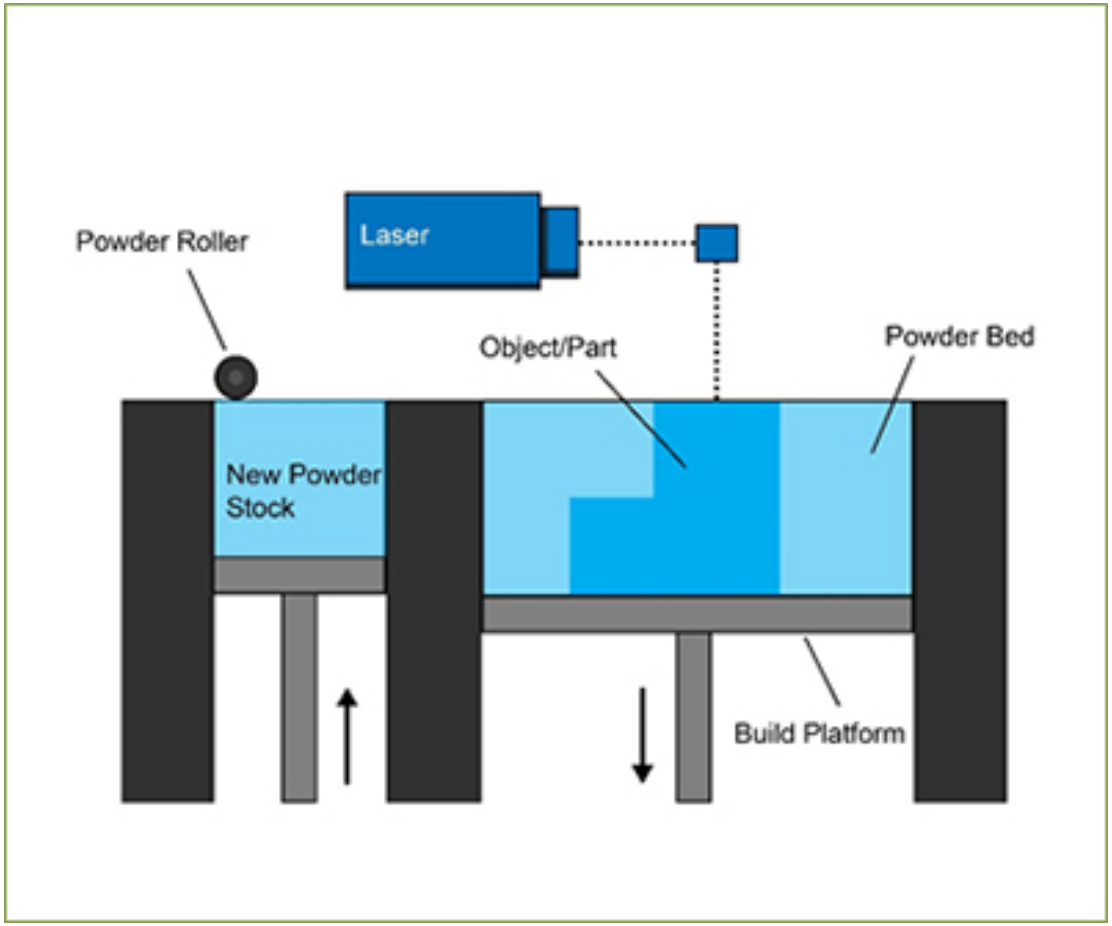
How it works

Process Parameters:

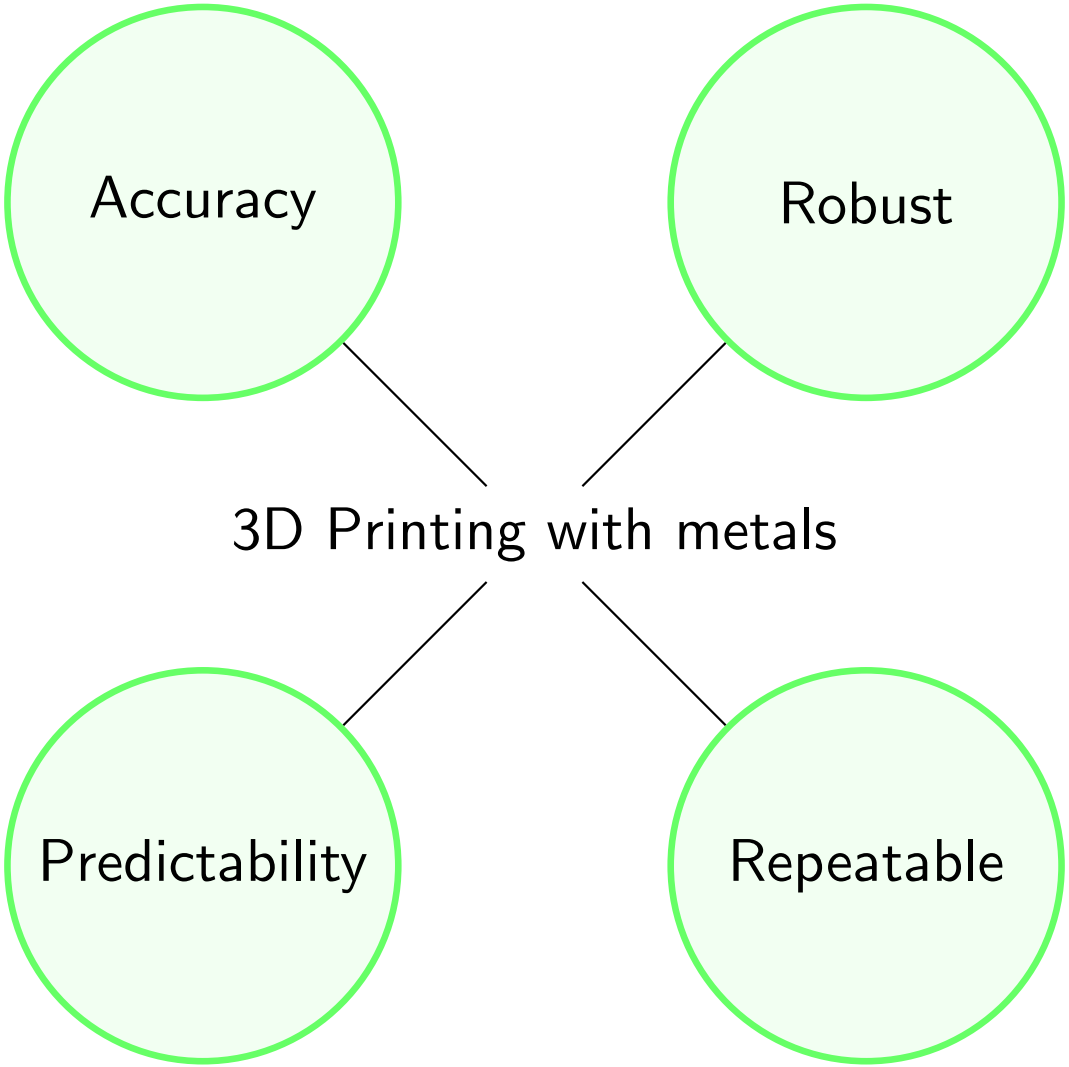
- Laser Power
- Scanning speed
- Hatch Spacing
- Build Direction

Key terms:

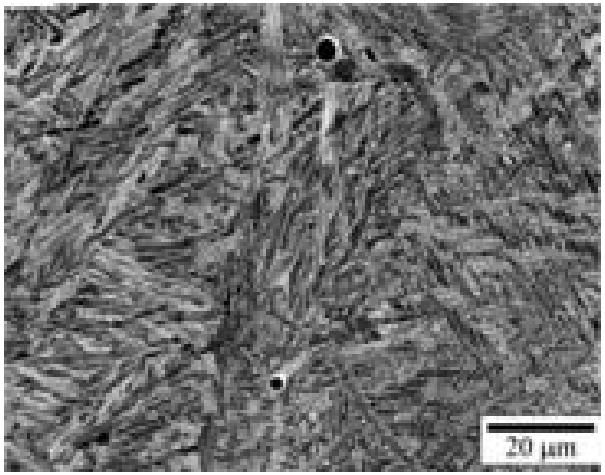
- Melt pool
- Power bed
- Raster Scan



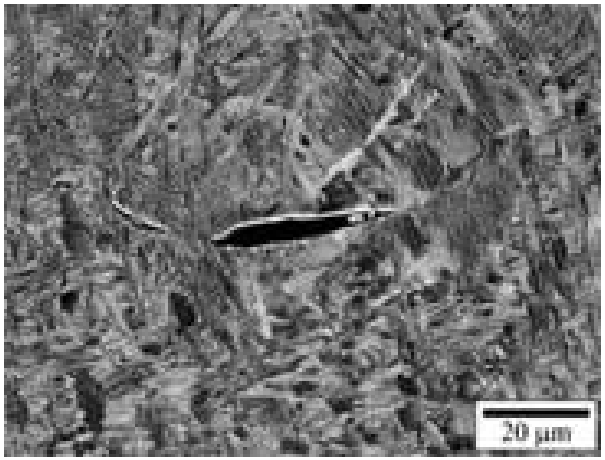
What is needed?



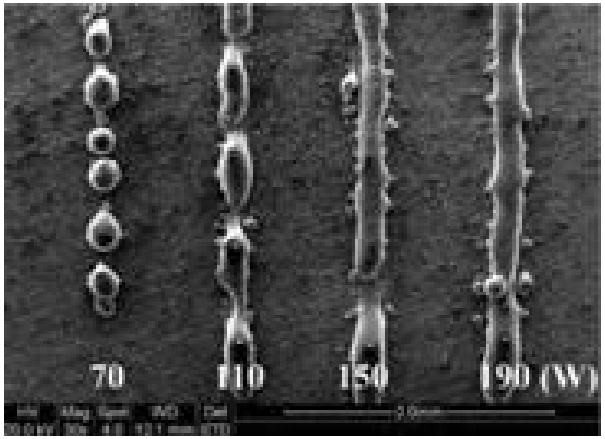
Defects



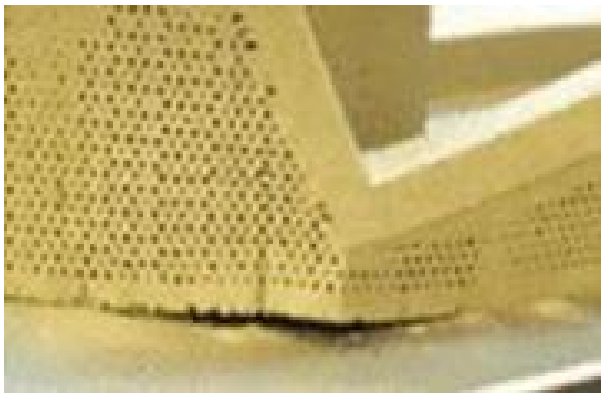
(a) Gas Pore



(b) Elongated Pore



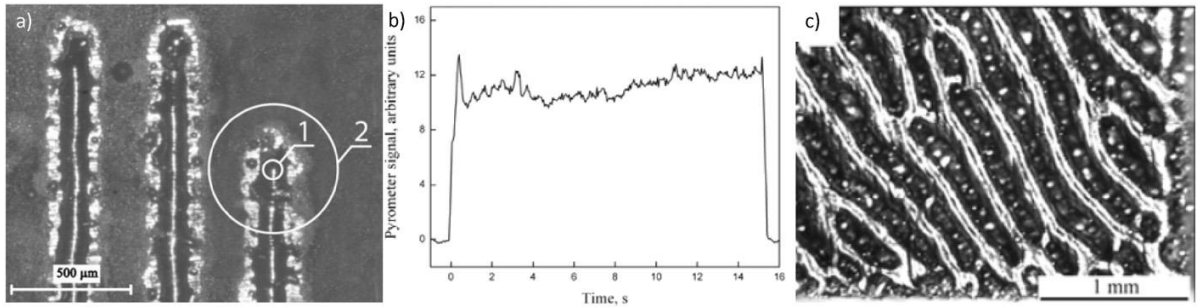
(c) Balling



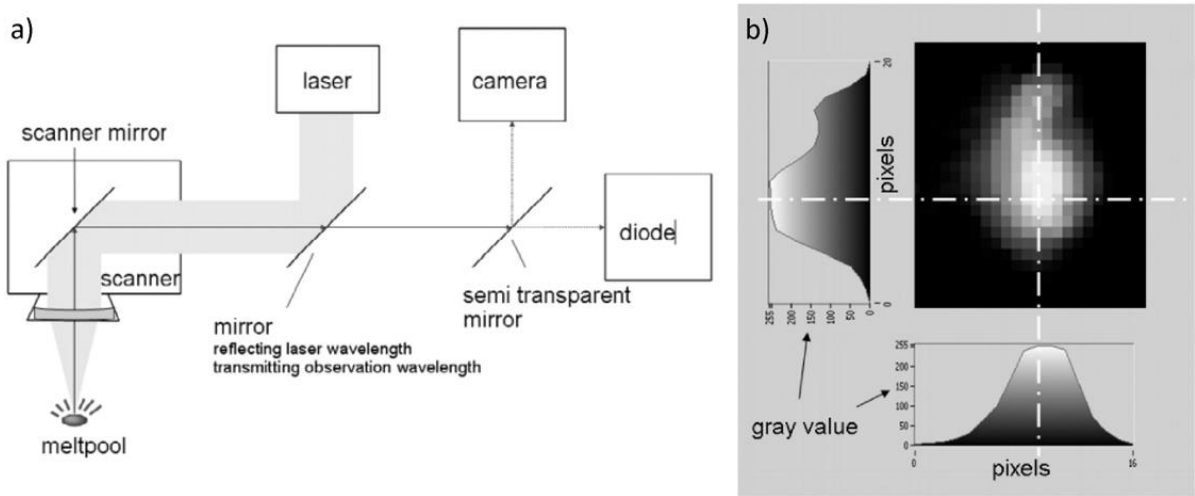
(d) Cracking

Figure: Examples of defects in 3D printing of metals

In-situ Monitoring and Data



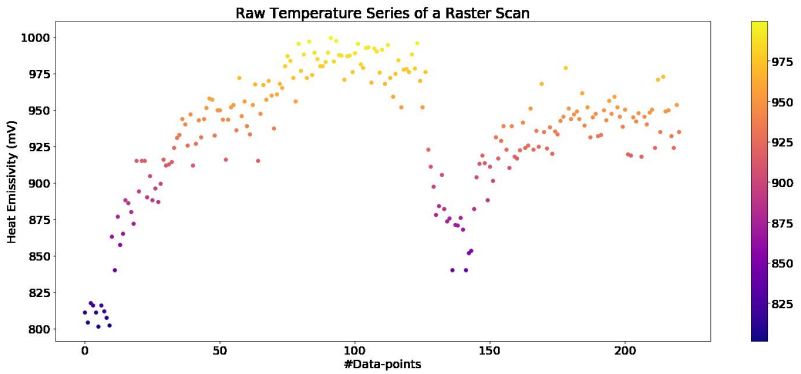
(a) Pyrometer



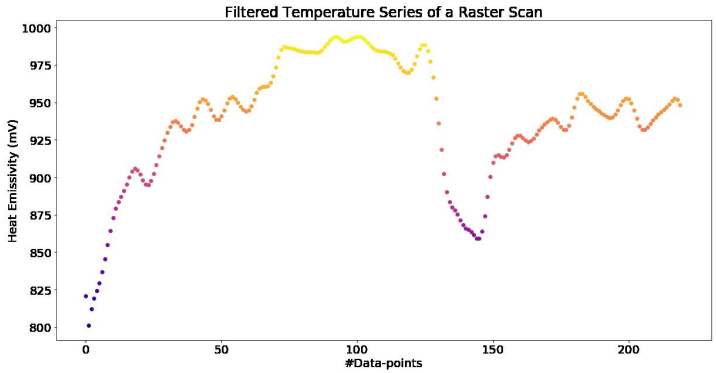
(b) Camera

Figure: In-situ monitoring techniques

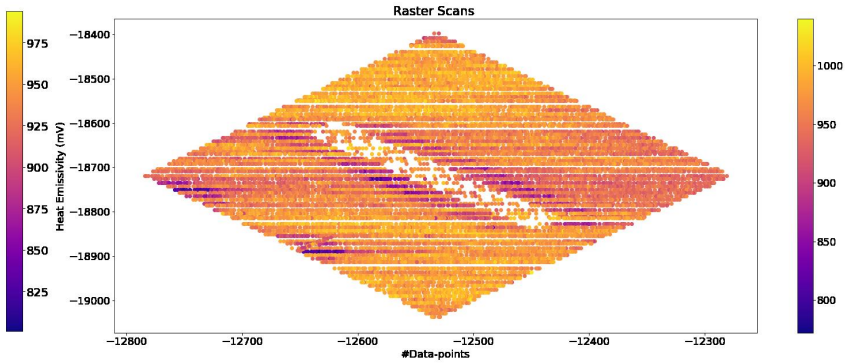
Pyrometer data



(a) Raw Pyrometer data



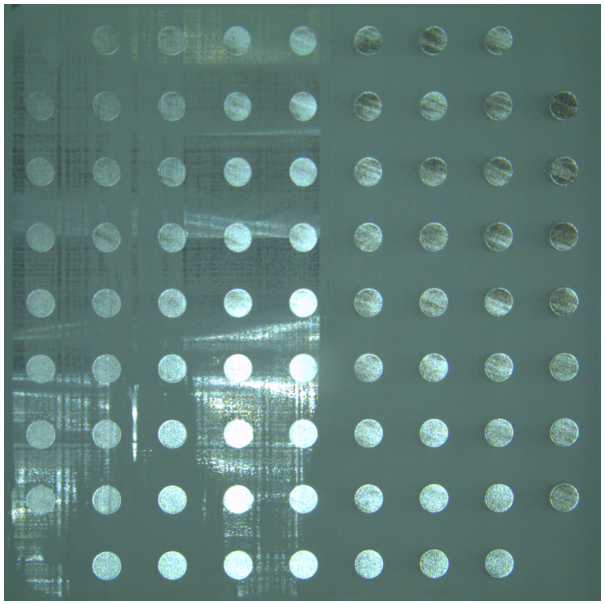
(b) Filtered time series data



(c) Full Layer

Figure: Collected data-

Image Data



(a) Melted Layer

(b) Powder Layer

Issues to be overcome

The Science

- **Real-time** detection of anomalies/defects
- Part quality and process optimization
- Data acquisition techniques
- Reducing waste/cost of printing procedures

The Field

- Standards for qualification (pre-processing and acquisition)
- Sharing of data from experiments

Thanks for listening!

Questions

Further Reading

- Mojtaba Khanzadeha, Sudipta Chowdhurya, Mohammad Marufuzzamana, Mark A. Tschoppb, Linkan Bian. *Porosity prediction: Supervised-learning of thermal history for direct laser deposition*. Journal of Manufacturing Systems Volume 47, April 2018, Pages 69-82
- Mojtaba Khanzadeha, Sudipta Chowdhurya, Mohammad Marufuzzamana, Mark A. Tschoppb, Linkan Bian. *A Methodology for Predicting Porosity From Thermal Imaging of Melt Pools in Additive Manufacturing Thin Wall Sections* June 2016 doi : 10.1115/MSEC2017-2909
- Luke Scime, Jack Beuth *Using machine learning to identify in-situ melt pool signatures indicative of flaw formation in a laser powder bed fusion additive manufacturing process*. doi : https://doi.org/10.1016/j.addma.2018.11.010