Data processing I: objects tracking challenge

Looking into predictive single-particle tracking techniques

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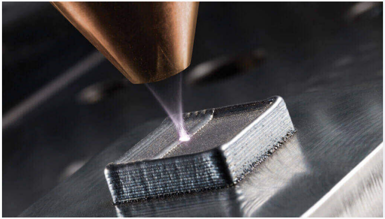
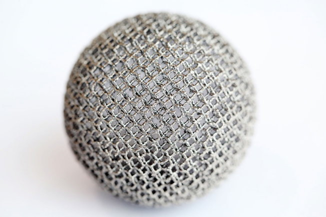
Diamond Light Source

What is additive manufacturing

- **Additive manufacturing** (AM) is a transformative approach to industrial production that enables the creation of lighter, stronger parts and systems[1].
- Additive manufacturing uses data computer-aided-design (CAD) software or 3D object scanners to direct hardware to deposit material, layer upon layer, in precise geometric shapes[2].
- The terms ‘3D printing’ and ‘rapid prototyping’ are the subsets of additive manufacturing.

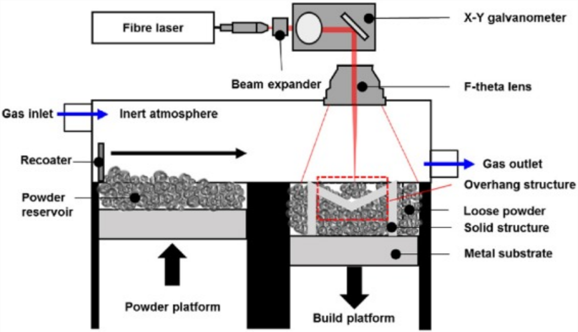




[1] https://www.ge.com/additive/additive-manufacturing
[2] https://www.youtube.com/watch?time_continue=71&v=kKQ5KwFwW_s

How the data have been collected

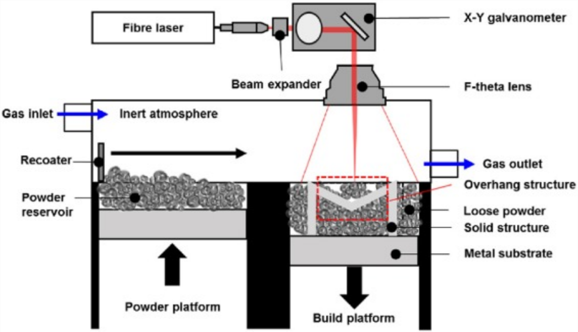
- I12 beamline [3] of DLS is used for very fast radiographic and tomographic imaging



[3] https://www.diamond.ac.uk/Instruments/Imaging-and-Microscopy/I12.html
[4] https://www.diamond.ac.uk/Science/Research/Highlights/2018/laser-additive-manufacturing.html

How the data have been collected

- I12 beamline [3] of DLS is used for very fast radiographic and tomographic imaging
- The series of radiographs were collected resulting in a 3D dataset (x,y + time), i.e. 3D process captured in 2D[4]



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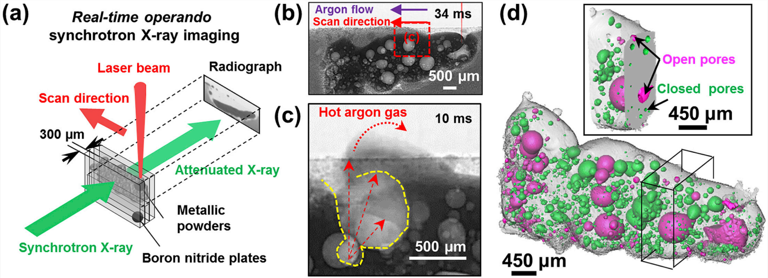
Laser melting process in details



See videos here: https://www.sciencedirect.com/science/article/pii/S1359645418309698

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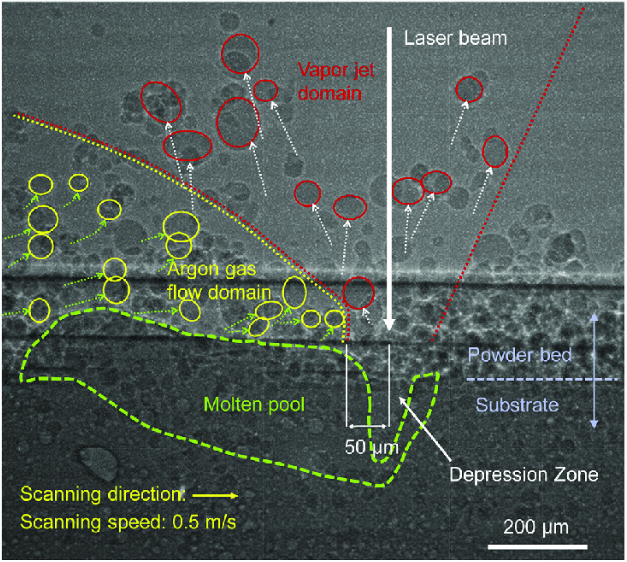

Image is taken from [1]

One data analysis pipeline

The following image processing pipeline was performed by Dr. *Alex Leung* et al. (UCL) [1, 3, 2] and it contained the following steps:

1. **Denoising** of time-series (radiographs) using state-of-the-art collaborative video block matching algorithm[5].

[5] http://www.cs.tut.fi/~foi/GCF-BM3D/
[6] https://arxiv.org/abs/1701.05940

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3. Manual **tracking** with ImageJ[6] and also the use of TrackMate software[4] (also available in ImageJ).

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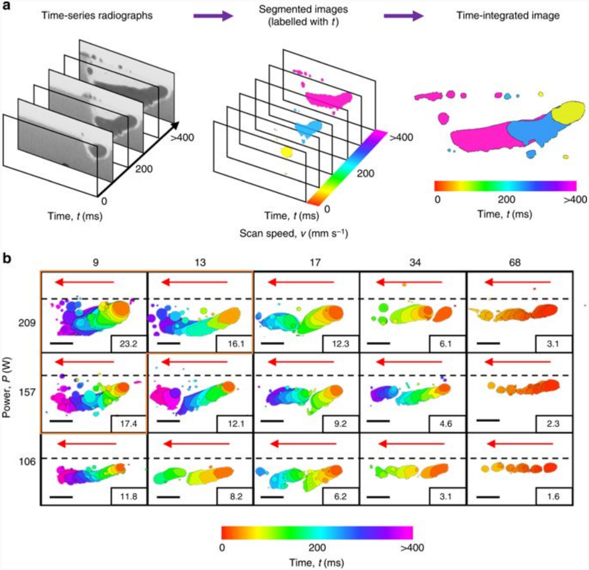
Some data processing stages



Challenges and methodology prospects

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2. Better background subtraction and segmentation methods
3. Objects classification and smarter tracking
4. Predictive models robustly estimating the path of a particle

Access to the data and software dependencies

- The raw I12 data are accessible at
  ITT_BATH_DLS/DataP_I_AdditiveManufact_tracking/rawdata
- Python script to read data (stack of tiffs) into Numpy 3D array
  ITT_BATH_DLS/DataP_I_AdditiveManufact_tracking/ITT_AM.py
- Python wrapper for Block-Matching denoiser
  https://github.com/ericmjonas/pybm3d
- Regularisation (denoising) package
  https://github.com/vais-ral/CCPi-Regularisation-Toolkit

All data have been kindly provided by Dr. **A. Leung** alex.leung@ucl.ac.uk and Prof. **P. D. Lee** peter.lee@ucl.ac.uk

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  In situ x-ray imaging of defect and molten pool dynamics in laser additive manufacturing.
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