



In situ monitoring of metal powder bed fusion for in-process defect identification

Afaf Remani

Supervised by: Dr Adam Thompson and Prof Richard Leach

Introduction

Additive manufacturing (AM) allows building components with high precision. However, techniques such as laser powder bed fusion (LPBF) still lack quality assurance due to defect formation. In situ monitoring techniques permit to closely inspect the build process and identify emerging defects. However, not all flaws are detrimental to part microstructure, hence the need to discriminate critical defects from harmless faults. We call this the **Hard Problem** and attempt to solve it.

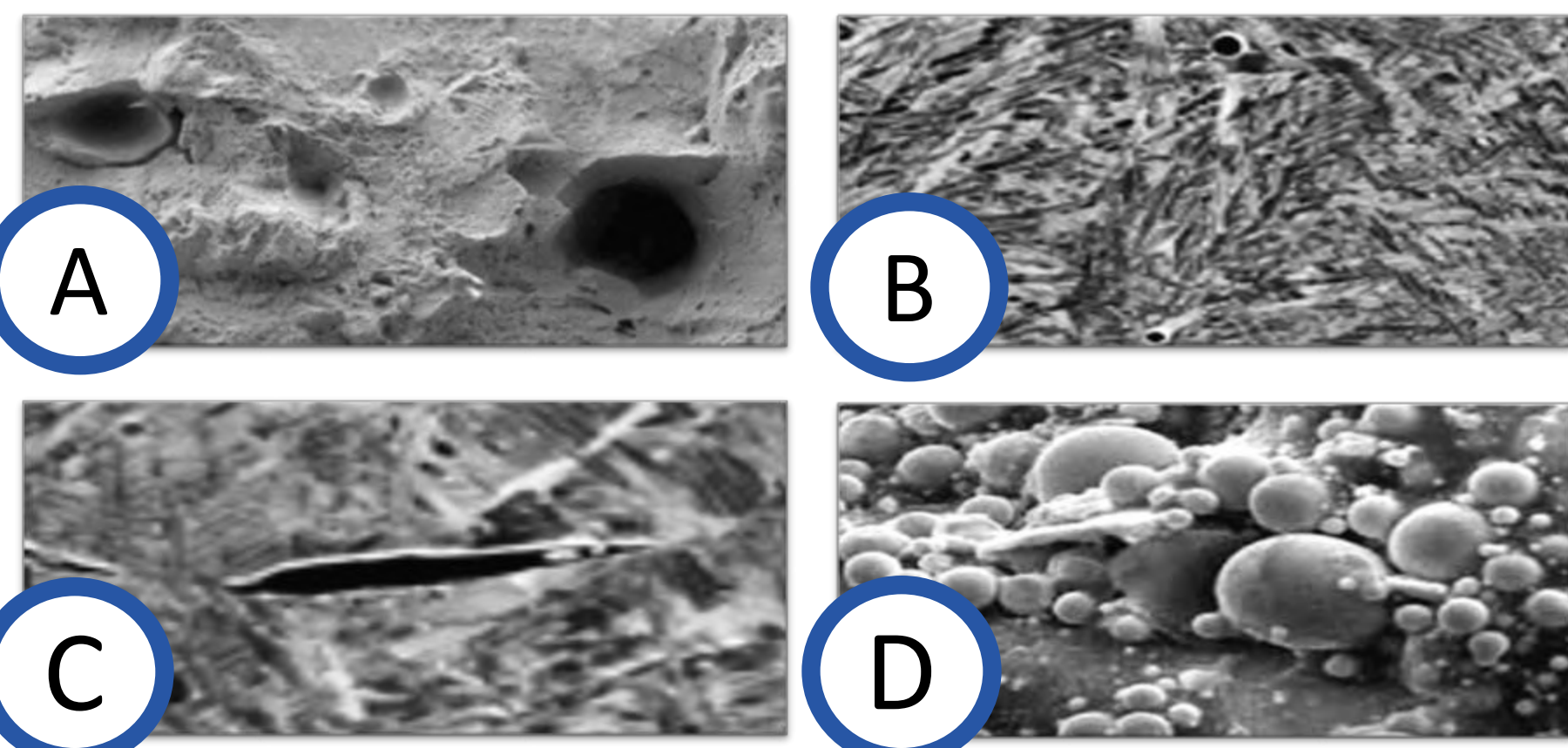
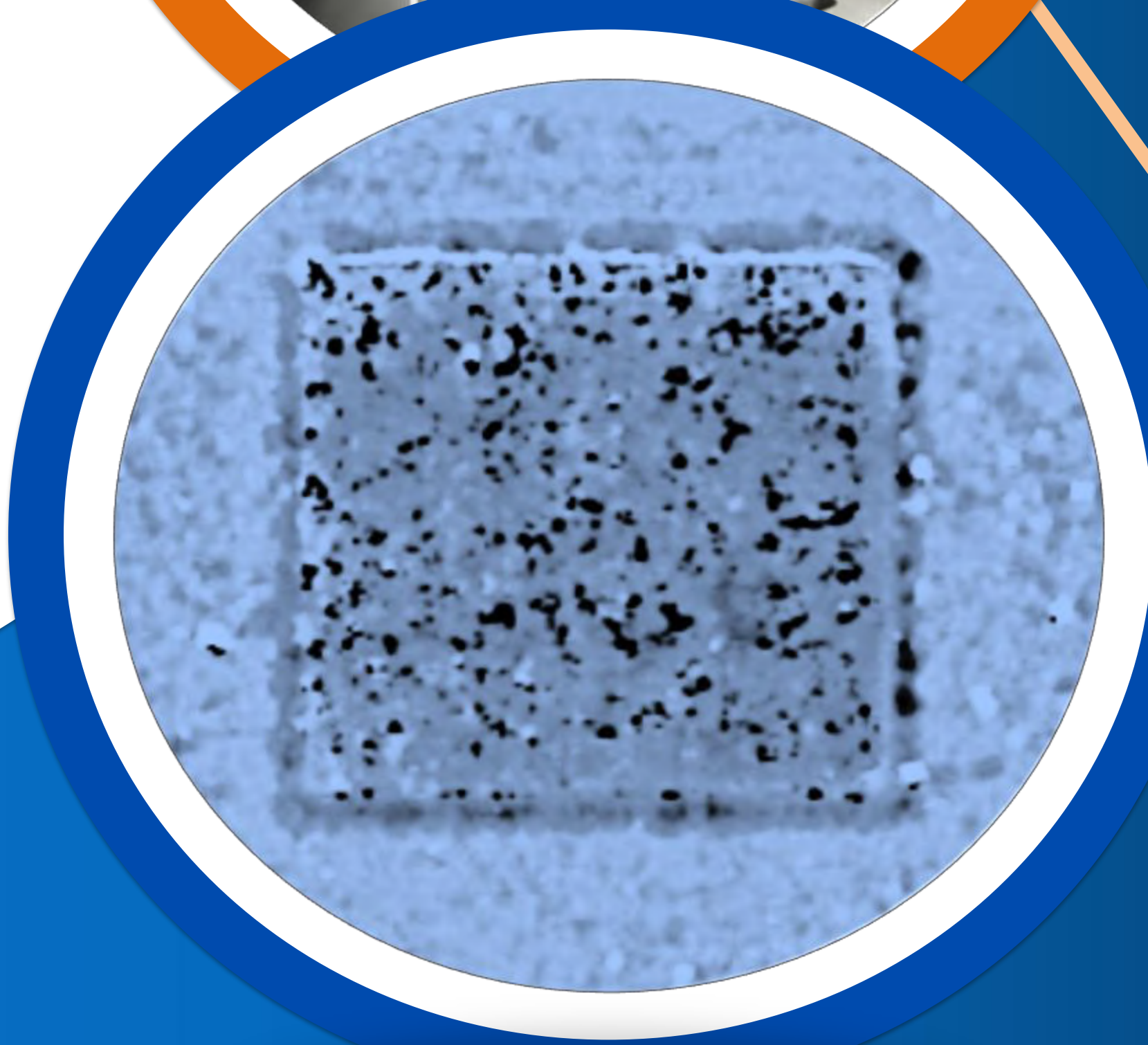
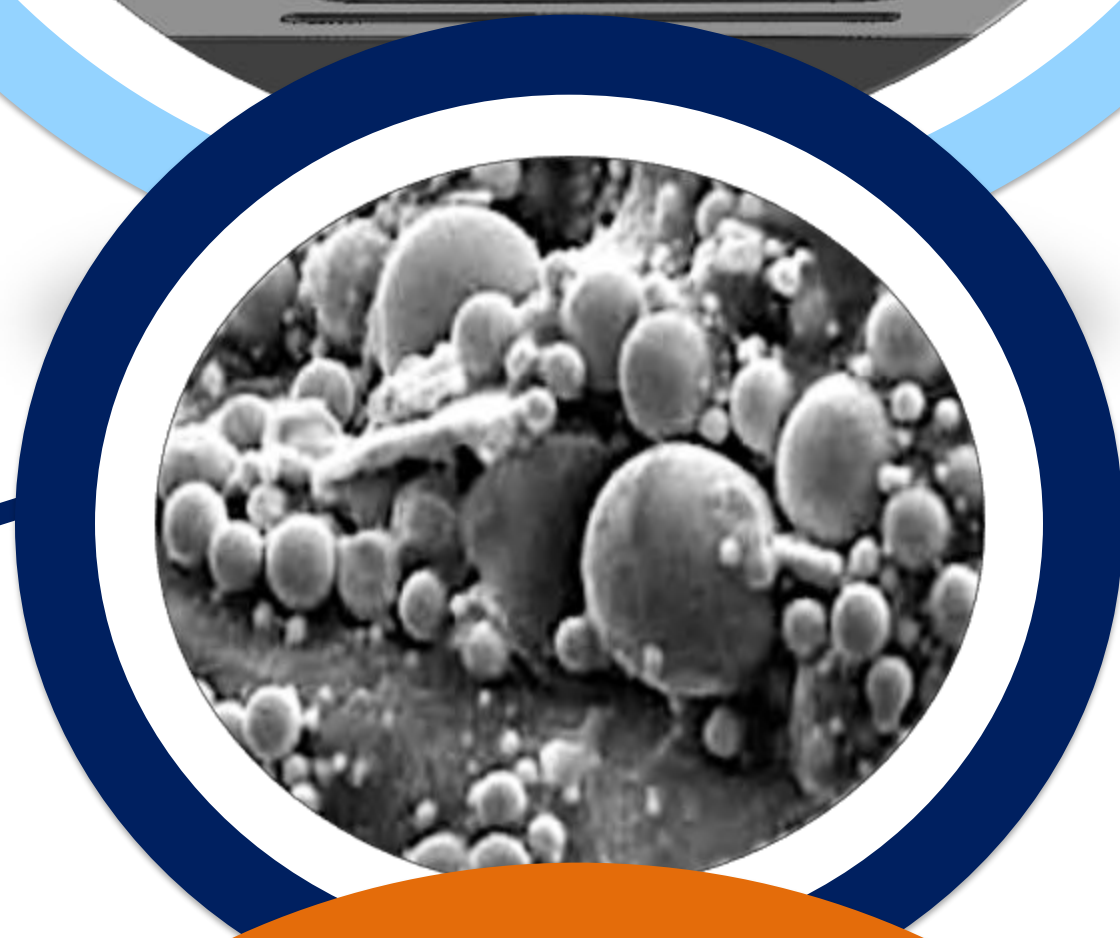
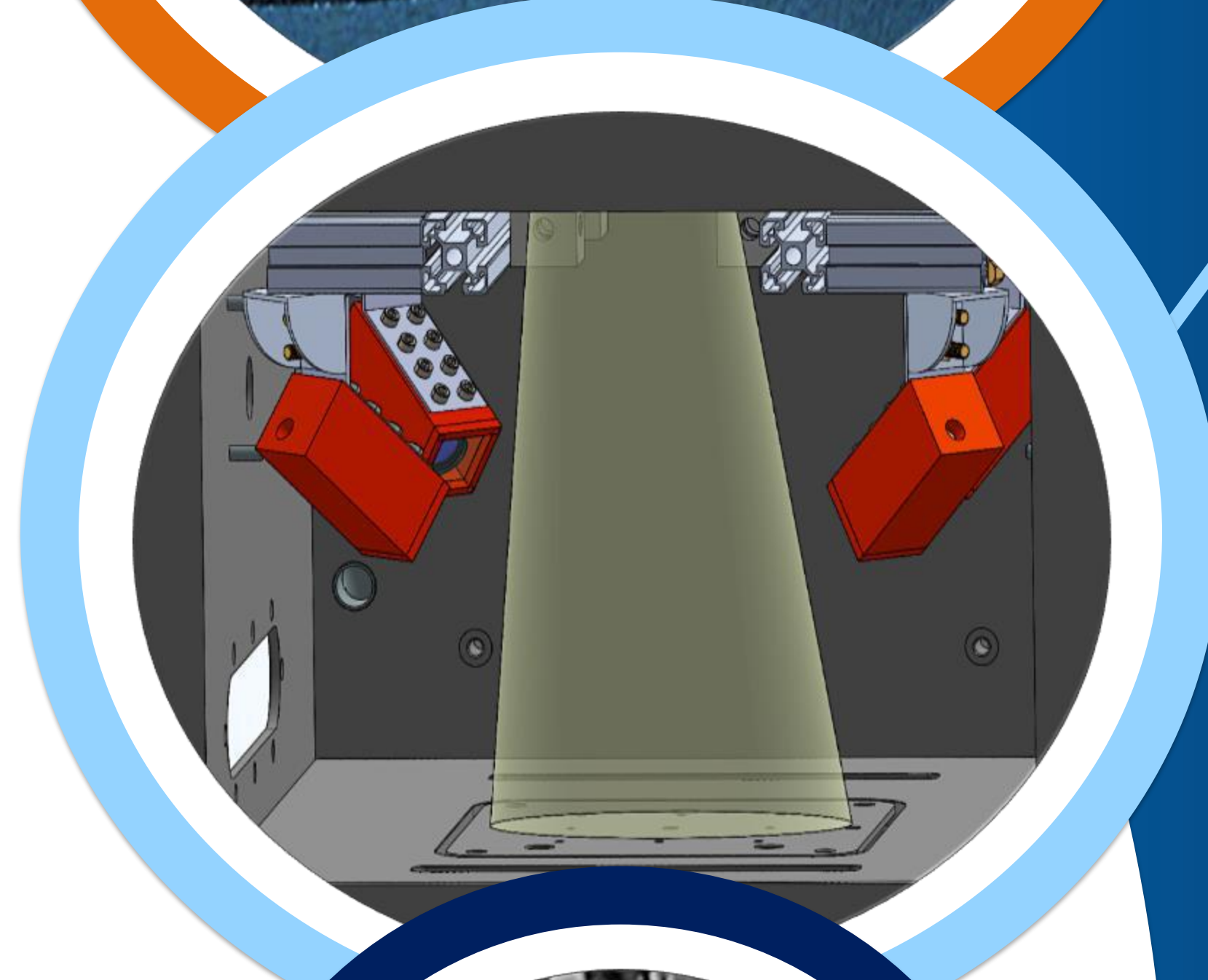
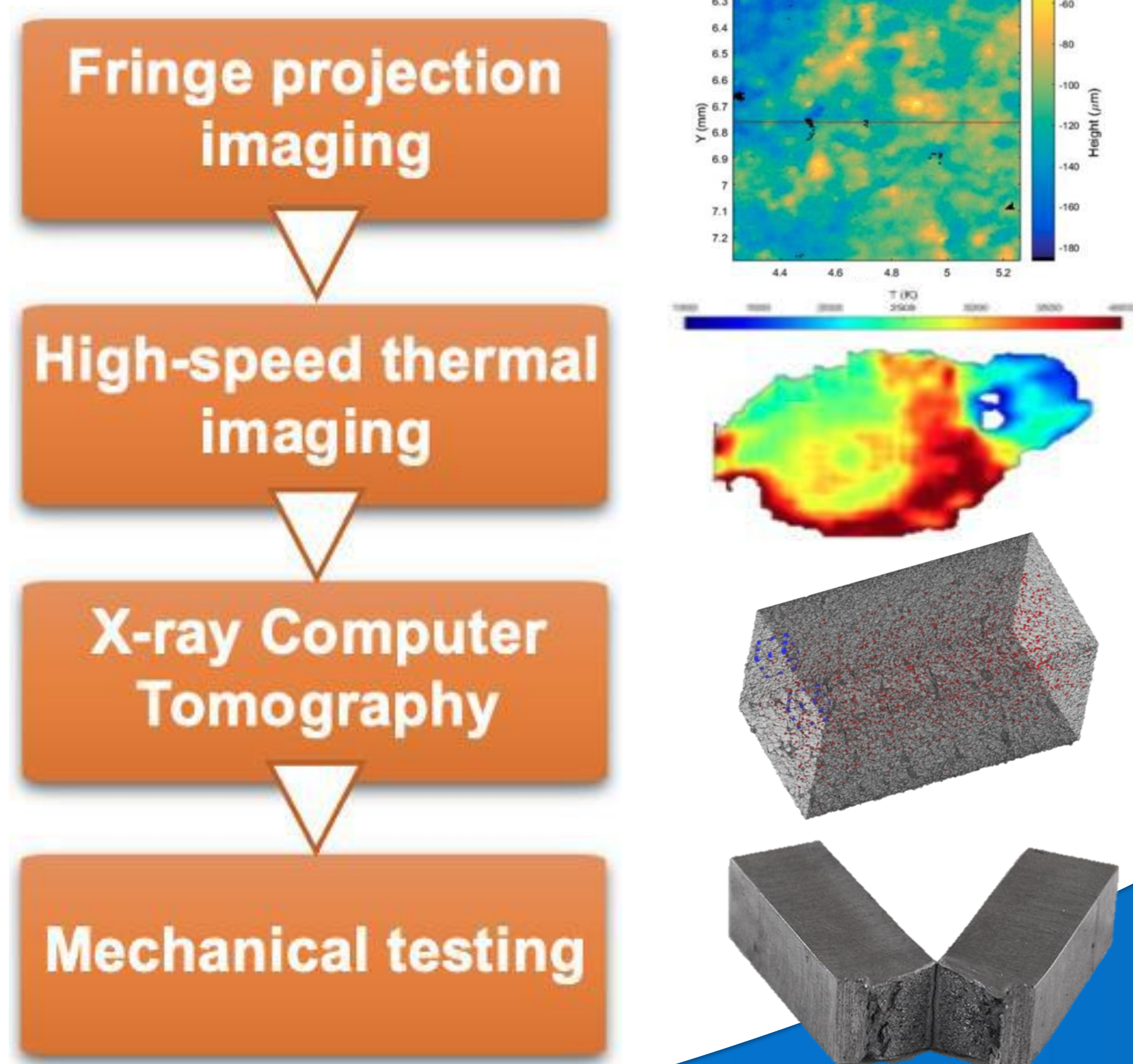


Figure 1. SEM images of common defects in laser powder bed fusion parts:

Methodology

- In situ monitoring of build layers using **multi-view fringe projection** and thermal imaging
- Ex situ verification of data agreement using **X-ray Computer Tomography**
- **Mechanical testing** to failure
- Analysis and matching of in-process and post-process data to **correlate defects with failure locations** and determine their influence on part integrity



Objectives

Development of a measurement pipeline to solve the **Hard Problem** in metal AM parts through the analysis of in-process layer data and qualitative correlations.

Experimental design

- A **four-camera multi-view fringe projection system** was designed for integration inside the Renishaw AM250 build chamber

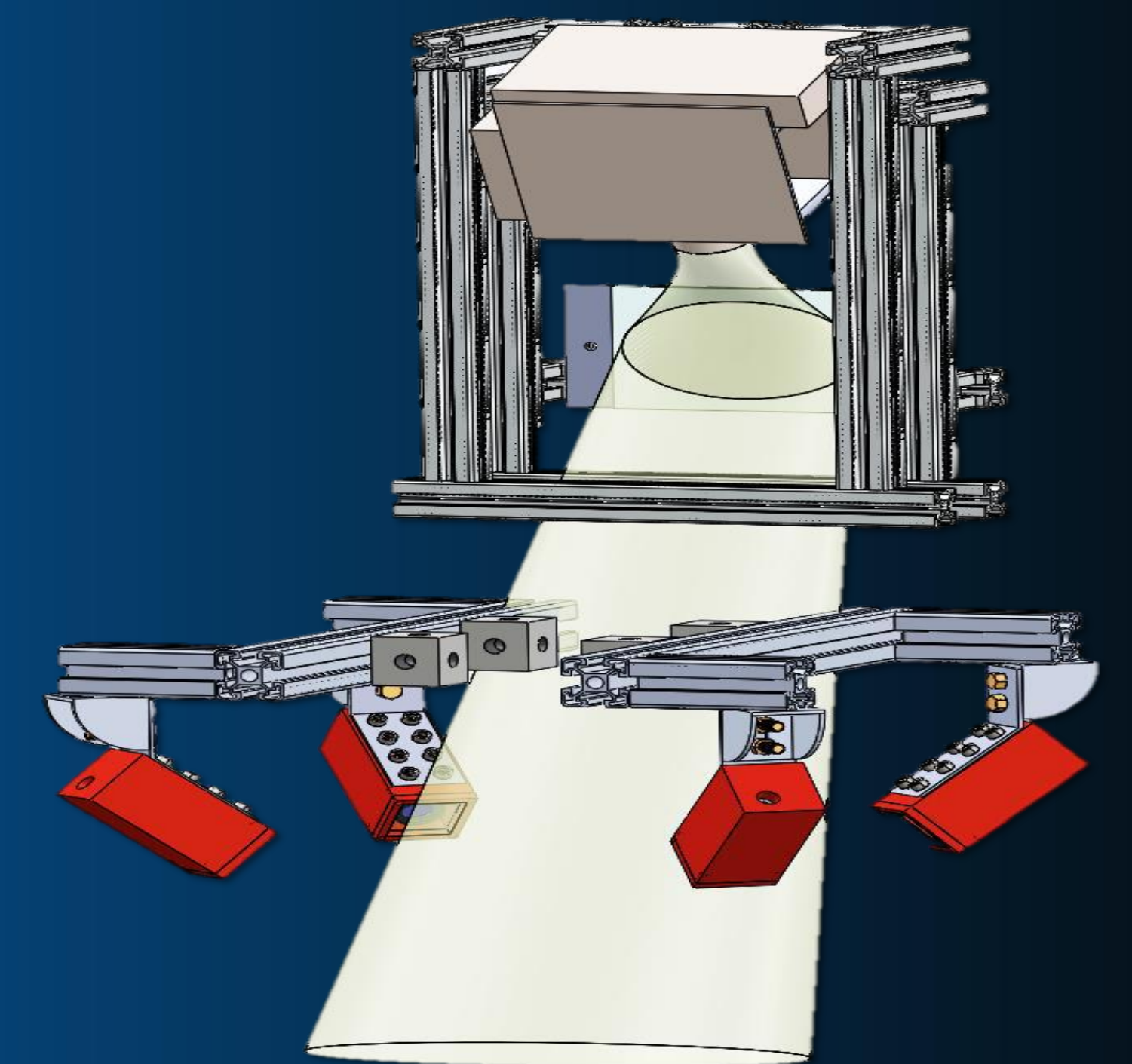


Figure 2. CAD model of the multi-view fringe projection system

- Optical calculations were performed to satisfy viewing requirements and **inspect regions of interest (ROIs)** of the powder bed

	Projector	Camera system
Working distance (mm)	679.47	274.95
Directional angle (°)	180	33.56
Vertical tilt angle (°)	24.60	48.30
Elevation (mm)	644.85	184.14
Horizontal field of view (mm)	292.32	346.86
Vertical field of view (mm)	170.70	231.24

Table 1. Optical calculations of the fringe projection system

Future work

The designed fringe projection system will be **physically built and installed** in the AM250 chamber. The **in situ and ex situ measurement pipelines**, described in "Methodology", will then be carried out and followed by results analysis.