

Analysis of strut bending defects in additively manufactured lattice structures by X-ray computed tomography

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Introduction

Lattice structures show potential as vibration isolating support frames for metrology instruments [1-2]. There is limited understanding regarding how lattice defects impact their performance in terms of natural frequency and compressive strength. This work presents the use of X-ray computed tomography (XCT) to obtain form data on the bending defects of a body centred cubic lattice structure (Figure 1). The aim is to use this data with finite element methods to further understand the impact of these defects and alter future designs to tolerate them.

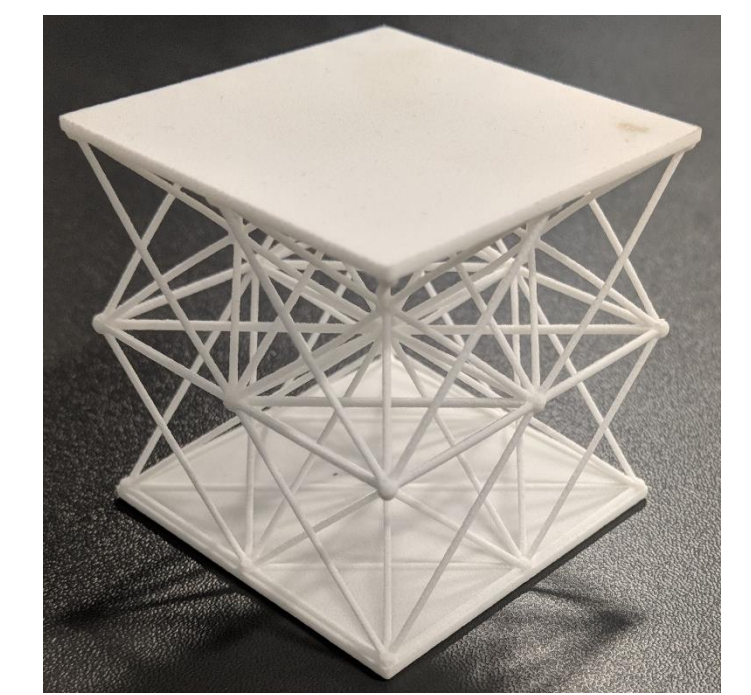
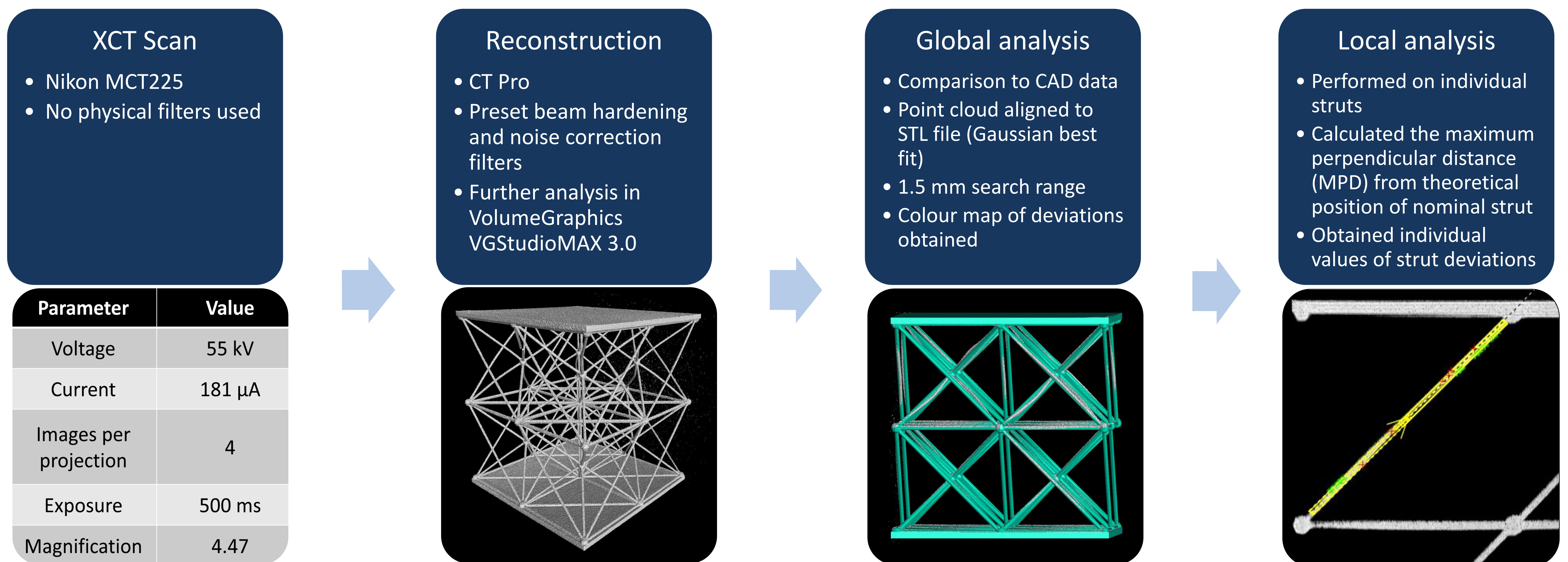


Figure 1. Lattice structure sample: Nylon-12, body centred cubic, 2 x 2 x 2

Methods



Results

Global analysis

- Colour map (Figure 2) shows a maximum deviation of approximately 1.2 mm
- An exact value of maximum deviation could not be obtained due to noise

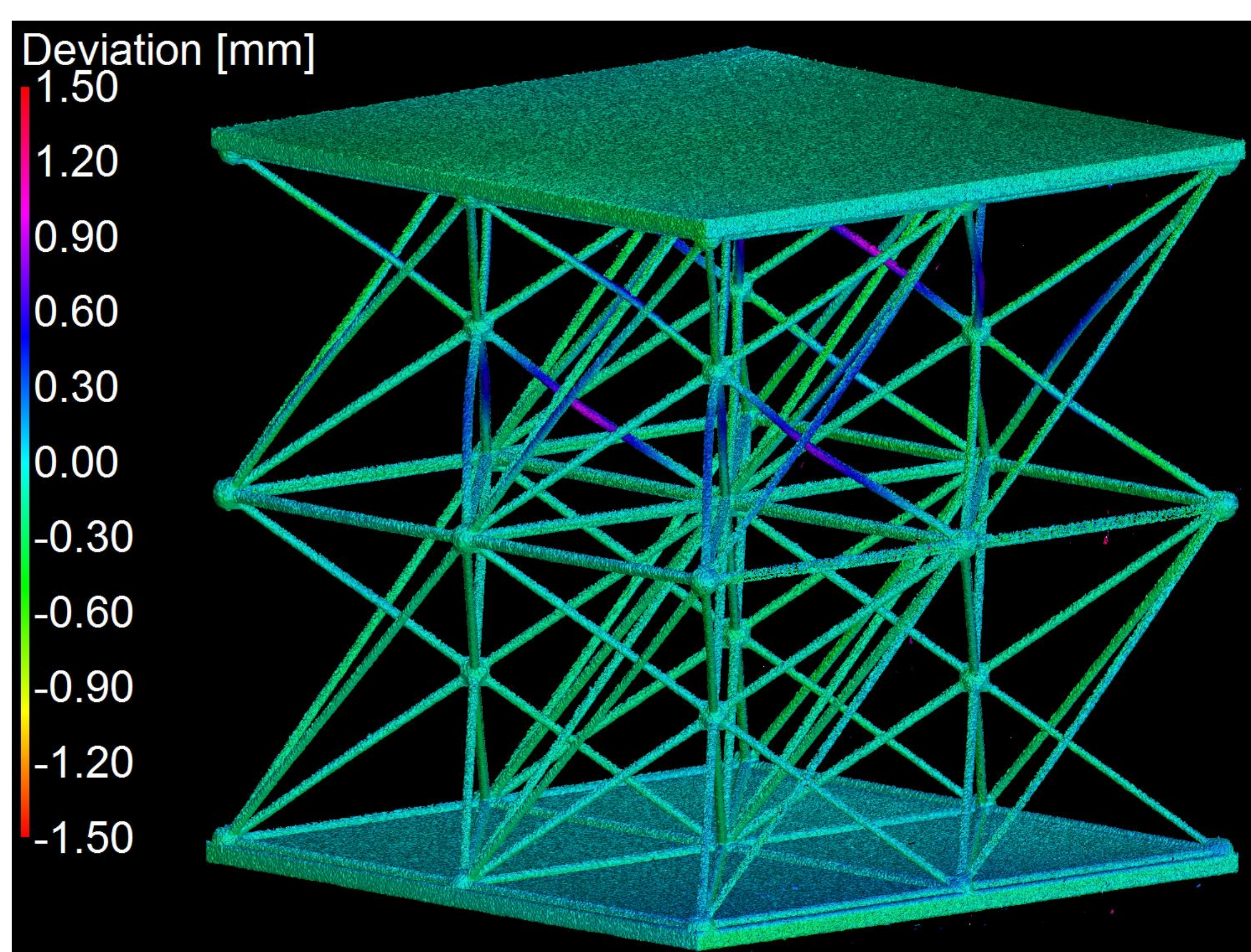


Figure 2: Colour map showing the deviations of the XCT point cloud to the CAD model

Local analysis

- Figure 3 shows the histogram of the MPD across all struts
- A maximum MPD of 1.77 mm and mean of 0.34 mm was observed

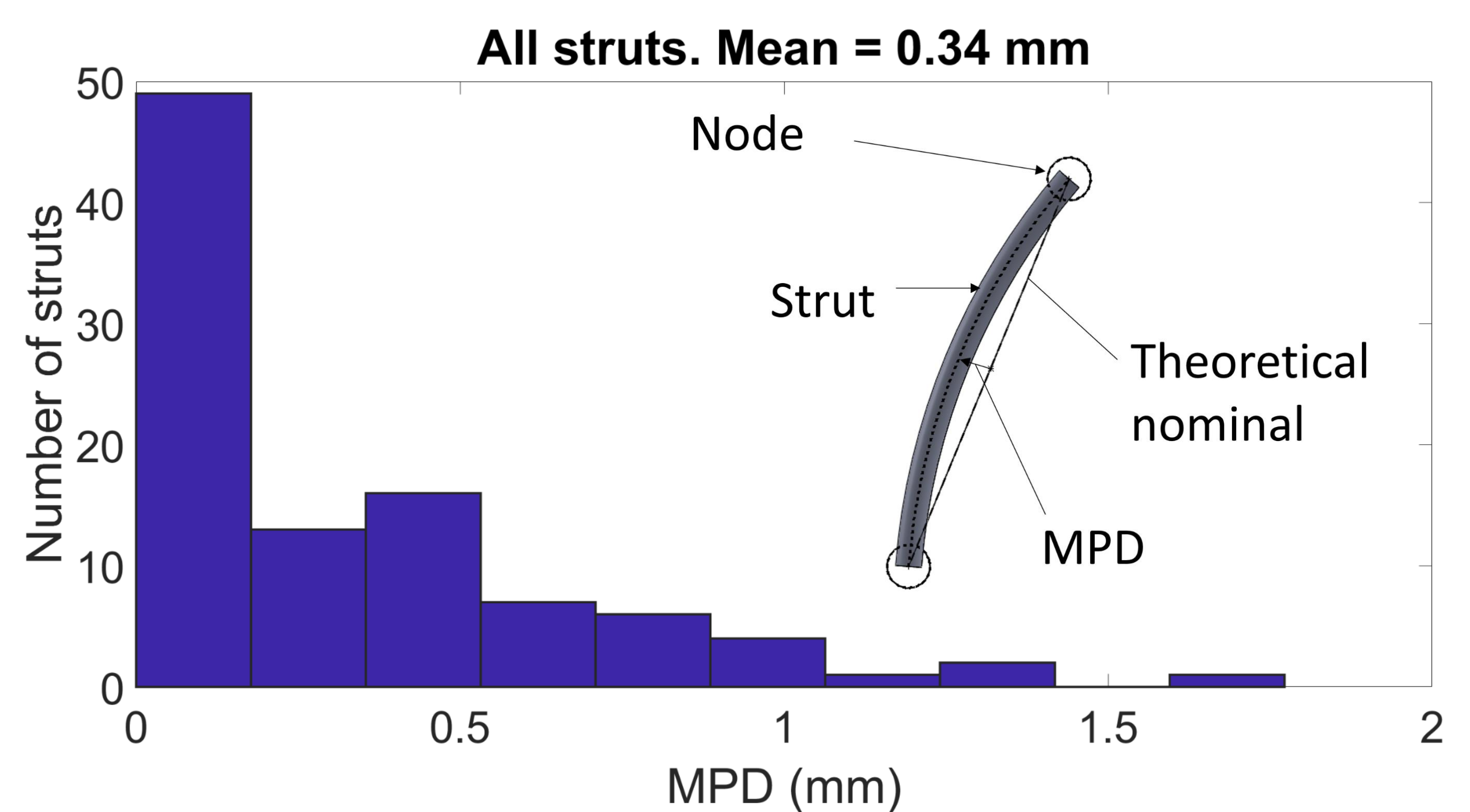


Figure 3: Histogram of MPD across all struts

Future Work

- Finite element models will be developed to use the obtained XCT data to predict the defects' impact on natural frequency and compressive strength
- Lattice design parameters (e.g. strut diameter) will be modified to bring the defects within tolerance
- Models will be validated using physical testing of printed samples

References

- [1] Elmadih W, Syam W, Maskery I, Leach R. Additively manufactured lattice structures for precision engineering applications 2017
 [2] Syam WP, Jianwei W, Zhao B, Maskery I, Elmadih W, Leach R. Design and analysis of strut-based lattice structures for vibration isolation. Precis Eng 2017;0-1

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