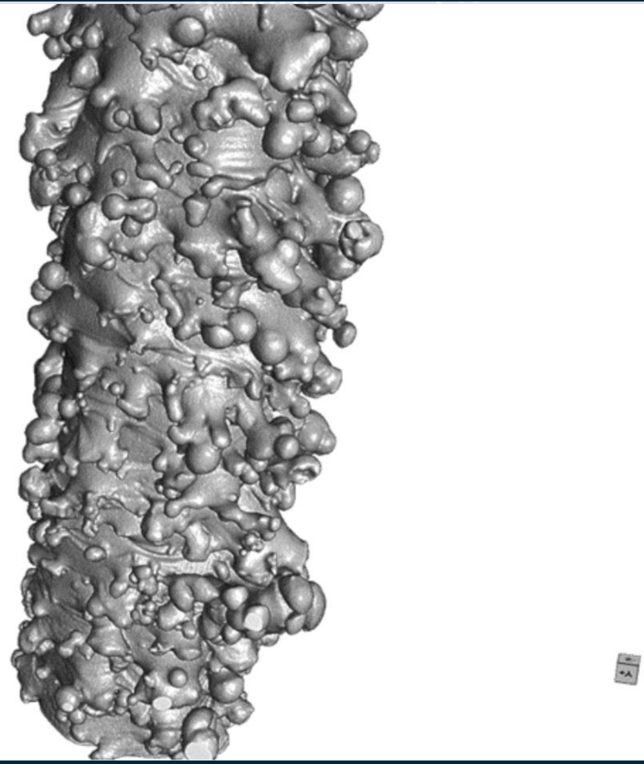
Application Note



# Local Wall Thickness Analysis on a Single Additively Manufactured Lattice Strut

What you will learn in this application note:

- How to make local wall thickness evaluation in Dragonfly
- Using the Mesh-thickness function
- Also using the volume thickness mapping tool
- The differences between the two and the benefits of each

Anton Du Plessis

dragonfly

# Introduction

This application note uses the example of a high-resolution X-ray CT scan of a single lattice strut, to demonstrate local wall thickness analysis using two different methods in Dragonfly 3D World. Wall thickness analysis is useful to understand the local thickness of manufactured parts in general, but additively manufactured parts often include surface-attached particles that can hide the underlying thickness by measuring small local thickness values of the particles. This application note shows both methods and how they can be applied to gain different types of information.

# Requirements:

A high-resolution micro-CT scan. The example here is a single lattice strut scanned at very high resolution but the tools demonstrated can be applied to any CT data. Credit to Prof Mathieu Brochu for sharing this dataset, it is also described in a publication spotlight – read more about that at Additively manufactured lattice structure surface morphology evaluation - Dragonfly. Besides data, a computer is needed with Dragonfly 3D World installed.

# Typical outputs:

- Local wall thickness 3D images and video
- Histogram for quantifying thickness distribution
- Thickness mesh type measurement: fast results, surface measurements only
- Volume thickness mapping measurement: full volumetric output
- CSV file outputs possible

# How does it work?

A cross section (top view) of the lattice strut is shown in Figure 1. Besides the expected circular shape, there are many attached particles and excess material. Also shown is the surface mesh – a simplified representation of the interface between material and air (white line, right).

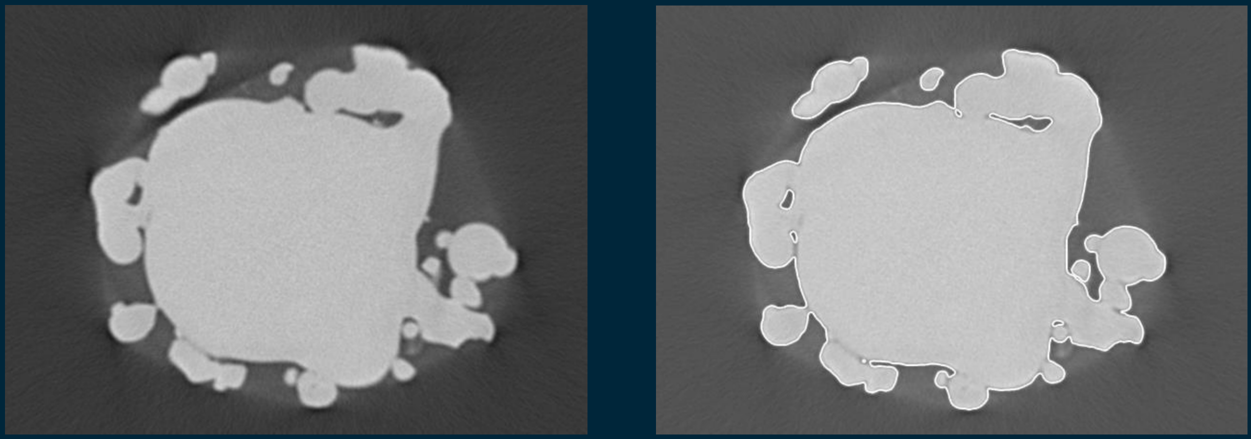


*Figure 1: Example of cross section (top view) of single lattice strut showing excess material and attached particles. White line shows surface mesh.*

The fastest method to calculate local wall thickness is to use the “mesh thickness” function. This calculates the local thickness at every surface mesh location (everywhere on the white line). This calculation is fully 3D and uses sphere fitting in the volume, but reports only the value for each surface point, saving a lot of time compared to measurements in every point in the volume. The result is shown in Figure 2 for this case in 2D and 3D.

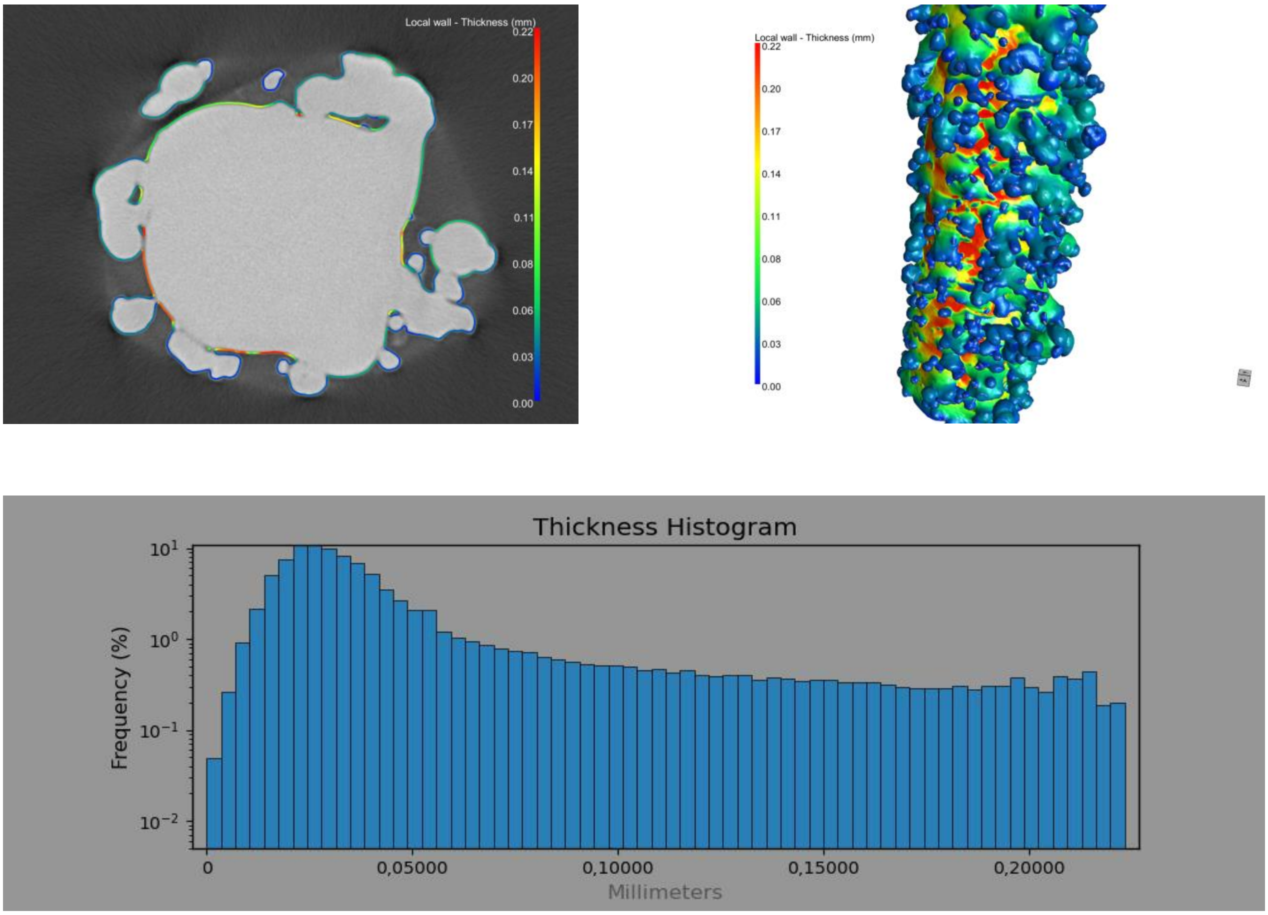



*Figure 2: Result of mesh thickness analysis method – showing the local wall thickness at every point on the surface. The statistical information reveals the mode of the distribution to be centred on 26 µm.*

As shown in Figure 2, the mesh thickness method highlights blue regions which are attached particles, where the local thickness is small due to the geometry/morphology. One can see an underlying red region that represents the strut without particles, and this can be seen to be 0.22 mm while particles are mostly blue (0.026 mm).

A second method of investigation is to use volume thickness mapping – this method reports one value for each voxel in the volume (not only at the surface). This provides information as shown in Figure 3. The calculation takes longer but is more fully representative of the entire volume.

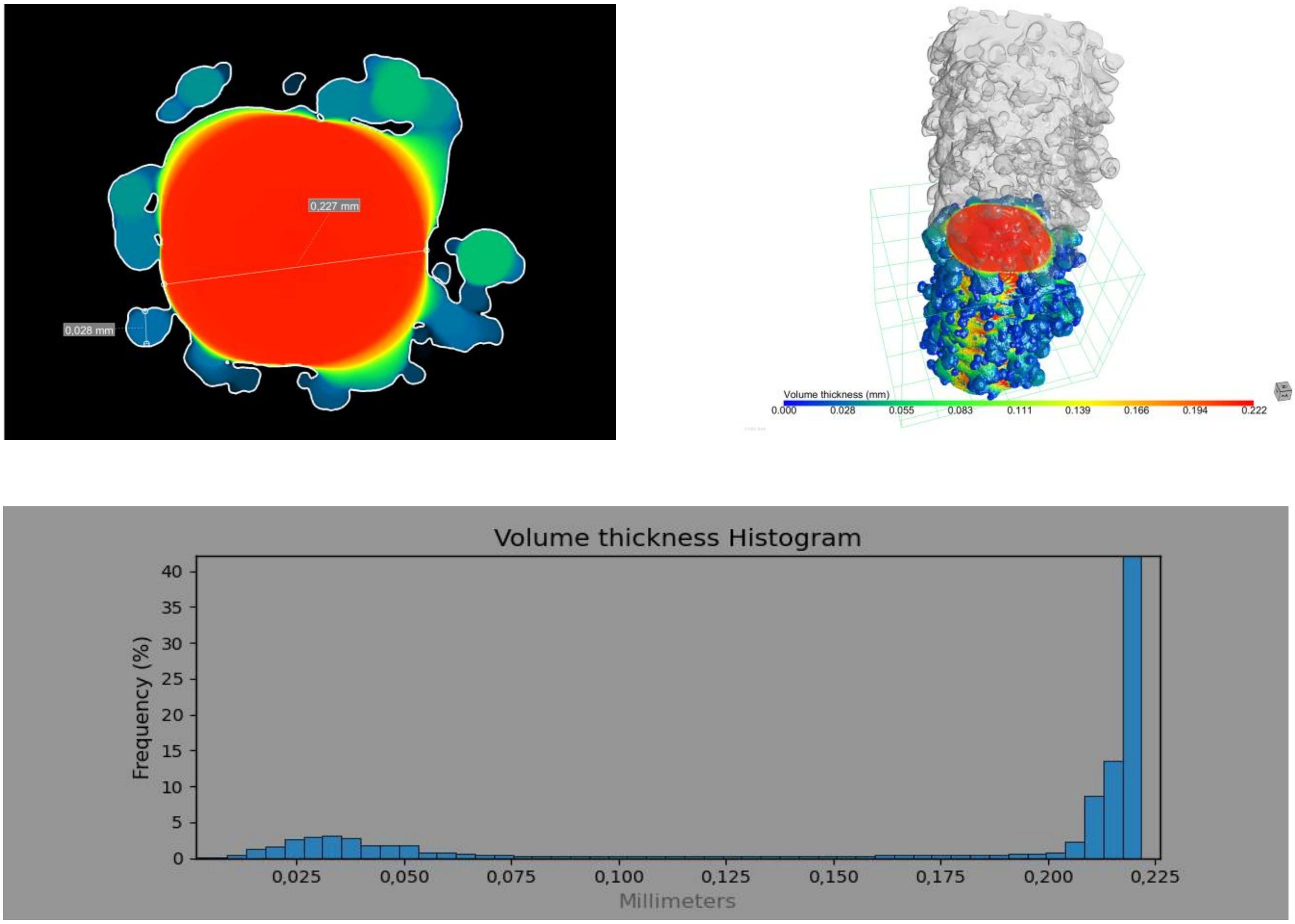



*Figure 3: Volume thickness mapping gives local thickness values for every point in 3D space, giving a more accurate representation over the full volume, at the cost of computational time. Here the second peak (the bulk of the measurements inside the strut) is more prominent, showing most of the strut to be 0.22 mm thick.*

The possibility to separate the internal strut from the excess material, using segmentation based on the volume thickness map, allows to “strip away” the excess material and visualize and analyze only that part of the strut that is functionally important. An example is shown in Figure 4.

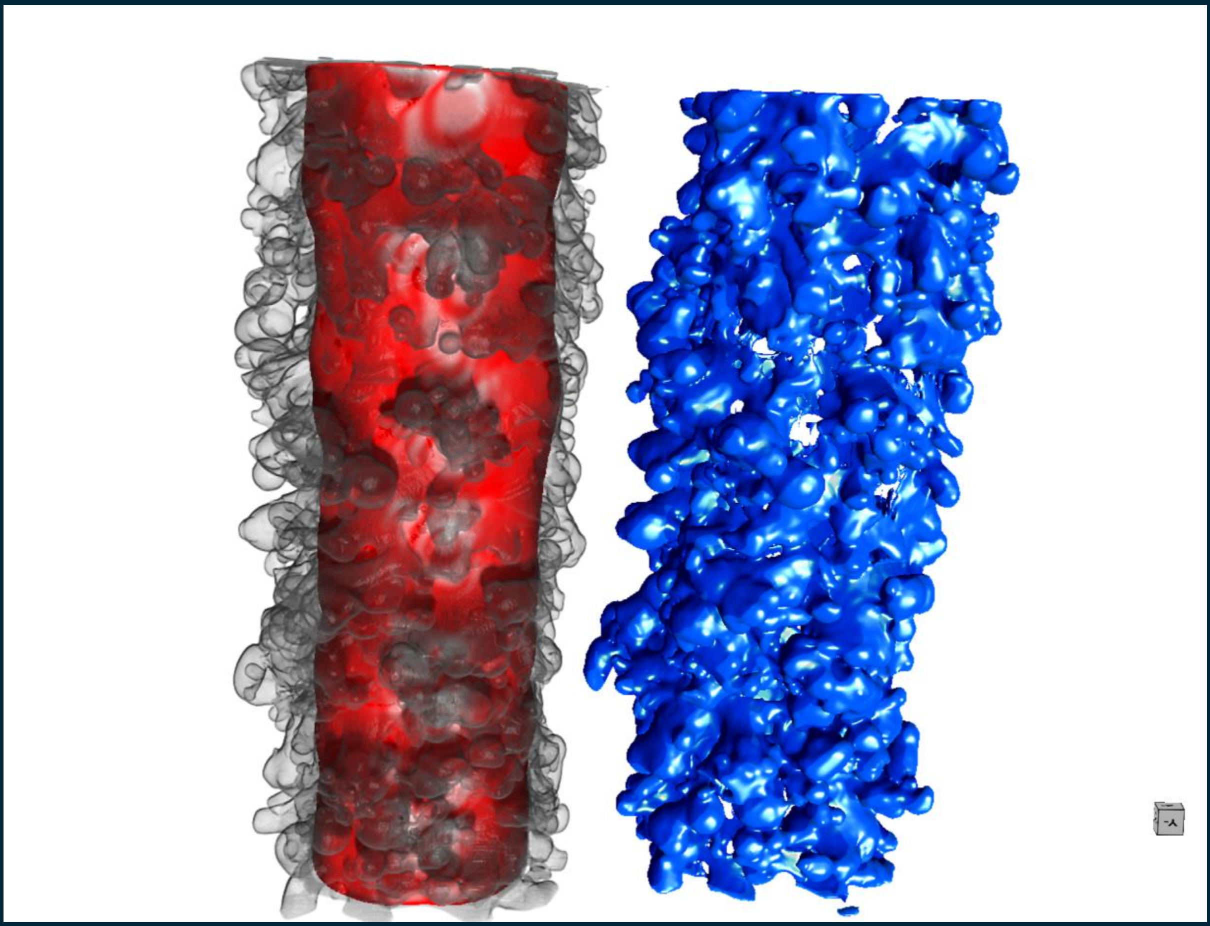


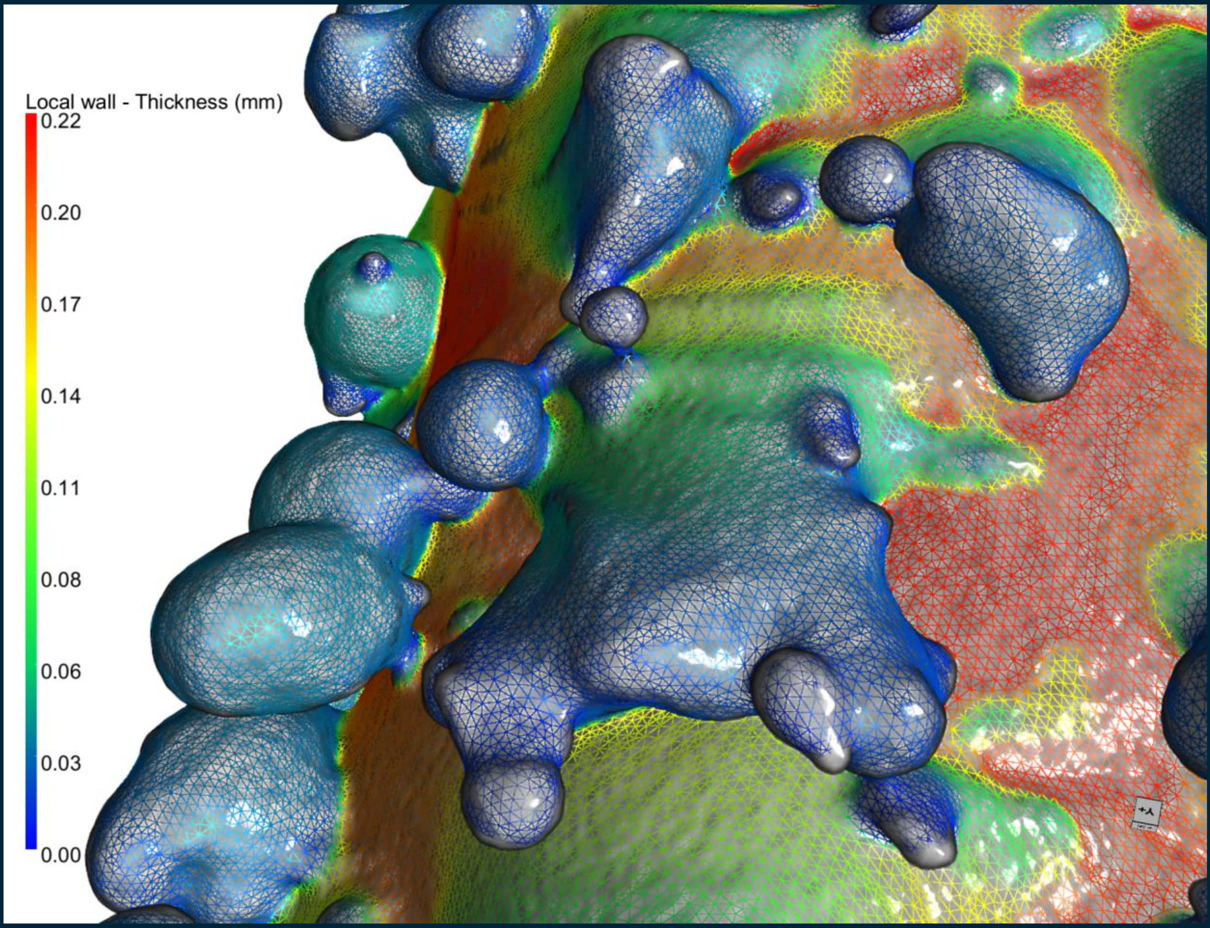
*Figure 4: Stripping away the excess material is possible to reveal the inner material that is most important for the load bearing aspect of the material. Red shows this inner material and blue shows the excess material stripped off.*

## Summary

- Local wall thickness analysis is possible by two methods
- Surface-only method is fast and powerful for typical applications
- Volumetric method is slower and gives information all over the volume, useful in some applications like in this one
- The methods can be used for further segmentation e.g. stripping away excess material

## The benefits

The main benefit of having different tools available for wall thickness analysis are to be able to fully characterize your 3D data and materials, and getting a full understanding of the local thickness where needed. Having information on hand about the local thickness can highlight areas with critically low thickness values, or with excess material as shown in this case.


Local wall - Thickness (mm)
0.22
0.20
0.17
0.14
0.11
0.08
0.06
0.03
0.00

For a video workflow demonstration of the above case:
https://www.youtube.com/watch?v=XhBIeA3exU8

Dragonfly - a brand of Comet
Comet Technologies Canada Inc.
460, rue Ste-Catherine Ouest
Suite 600
Montréal (Québec)
Canada H3B 1A7
dragonfly.comet.tech