



**ASME® 2020 IDETC-CIE**

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VIRTUAL CONFERENCE

AUG 17–19, 2020

# Relation between XCT porosity & CX images?

Problem #2

Deep fusion

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## PROBLEM DESCRIPTION

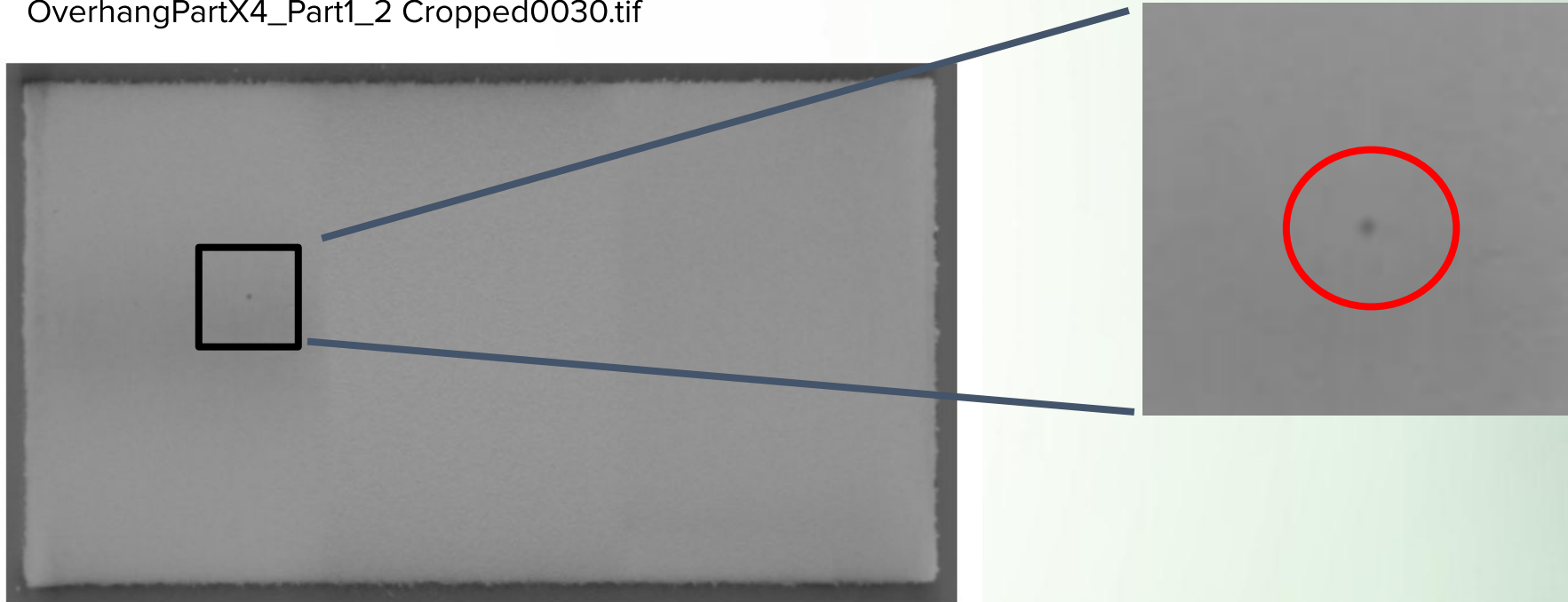
- Introduction

- Porosity is a big problem as it might causes premature part failure
- Can be found in ex-situ XCT data but not in-situ in real-time
- In-situ data (melt pool images, part surface) available
- Is there a relation between pores in XCT and in-situ data?



## Porosity example

OverhangPartX4\_Part1\_2 Cropped0030.tif





## Approach

- Use XCT images as a source of ground truth about porosity
- Identify XCT pore locations
- Map nominal image locations (from XY) to true coordinates (DAQ)
- Map coordinates from XCT pixel space to galvo coordinates
- Observe the melt pool images from pore proximity



## Approach: XCT

Could use computer vision or machine learning algorithms to locate pores  
So far, mapped several of them manually

To map pixels into X,Y in real-world units [mm]

1. Binarize the image (imbinarize)
2. Find bounding box
3. Analyze the distribution of bounding boxes for whole XCT stack





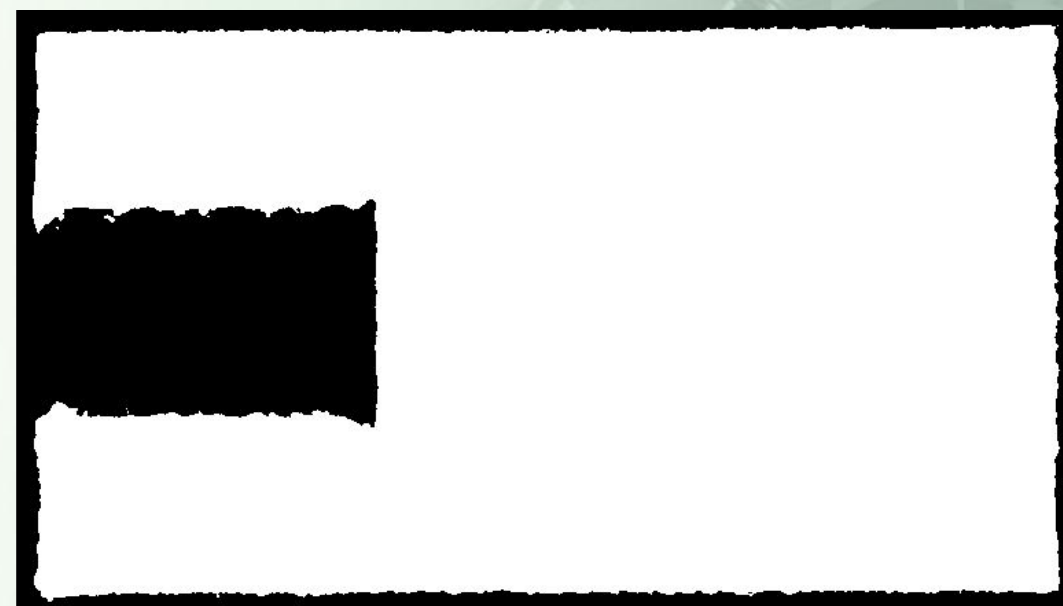
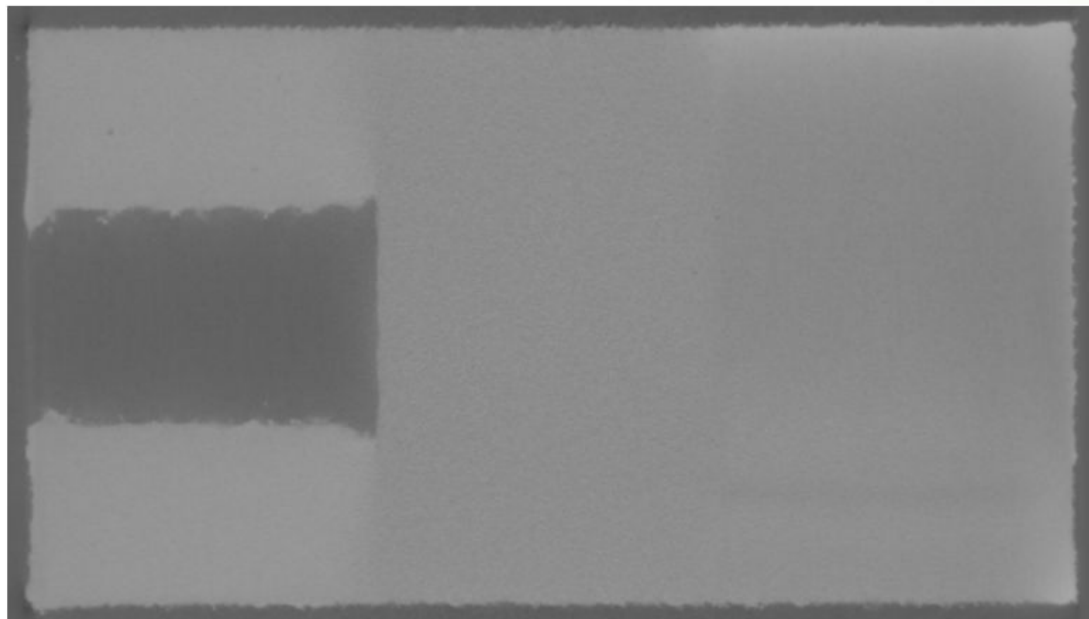
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## Approach: XCT: binarize the slice



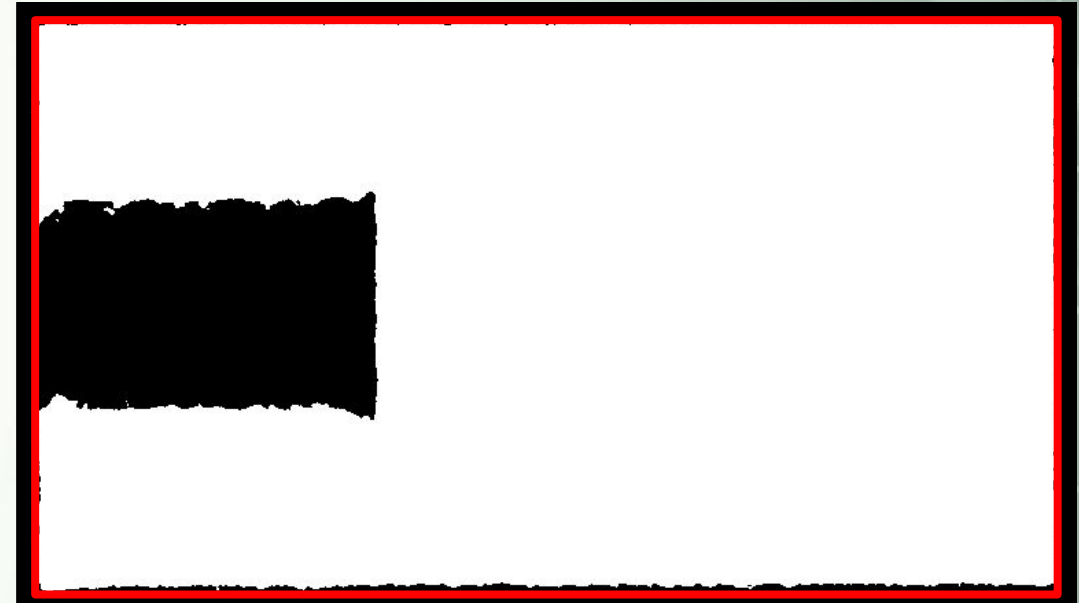


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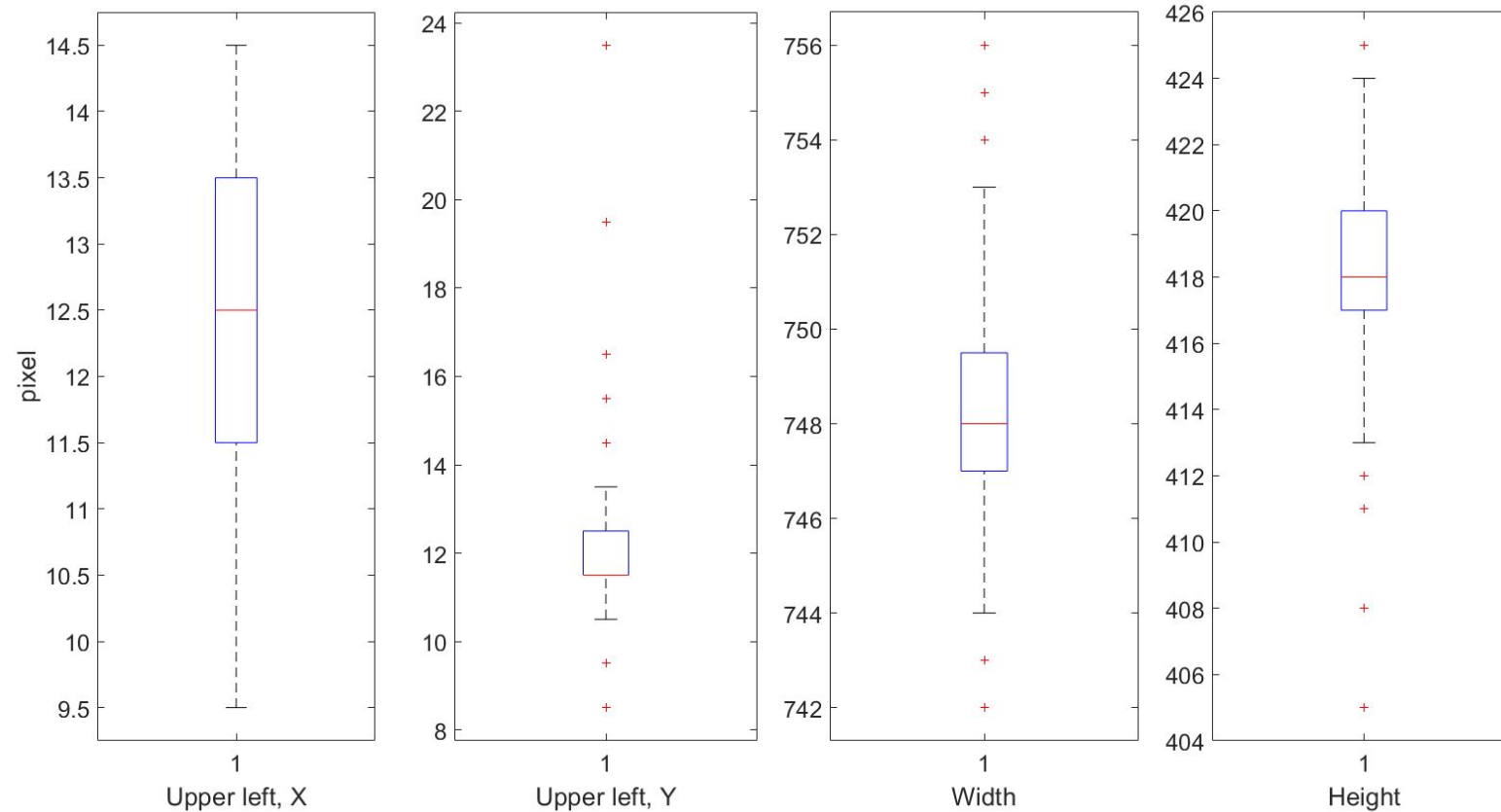
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## Approach: XCT: bounding box for the slice





# Approach: XCT: variation in XCT boundary



**Part is prismatic so BBs should overlap**  
**Median as estimate of boundary location**





# Approach: coaxial images locations

## Problem

Trigger in nominal coordinates

Nominal  $\neq$  DAQ coordinate

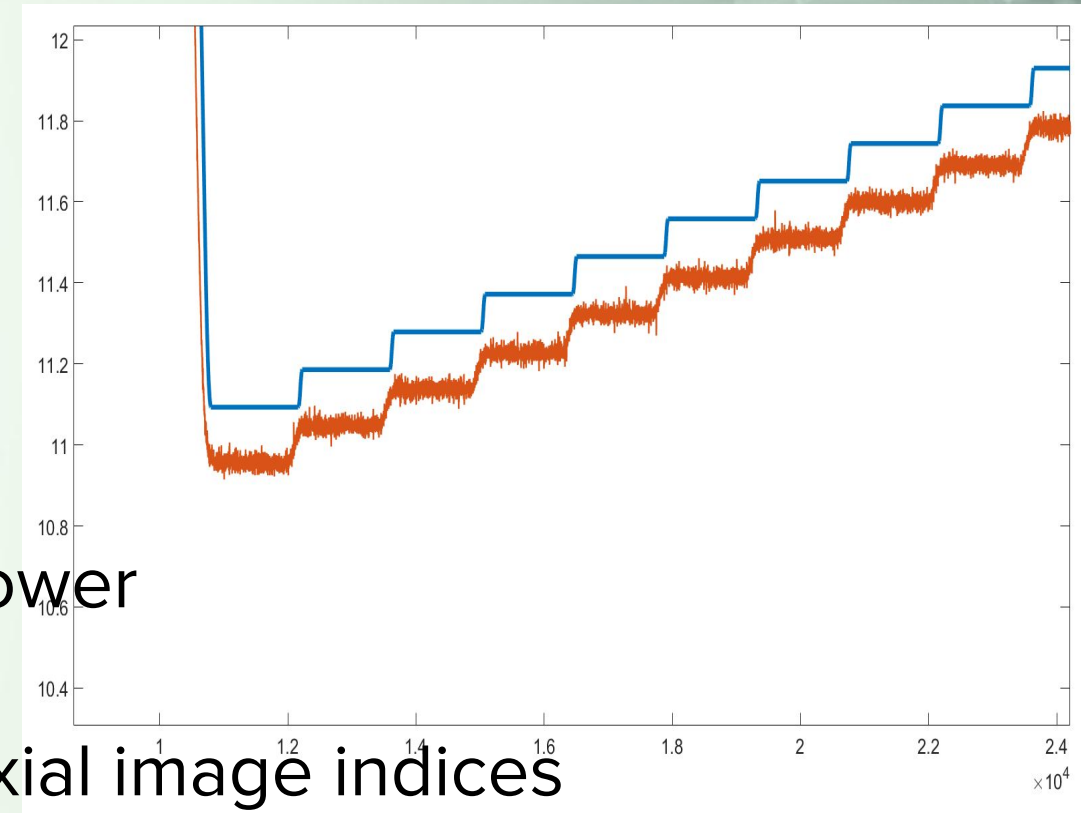
## Solution

Drop entries without triggers

Align nominal & DAQ by 1st “non-zero” power

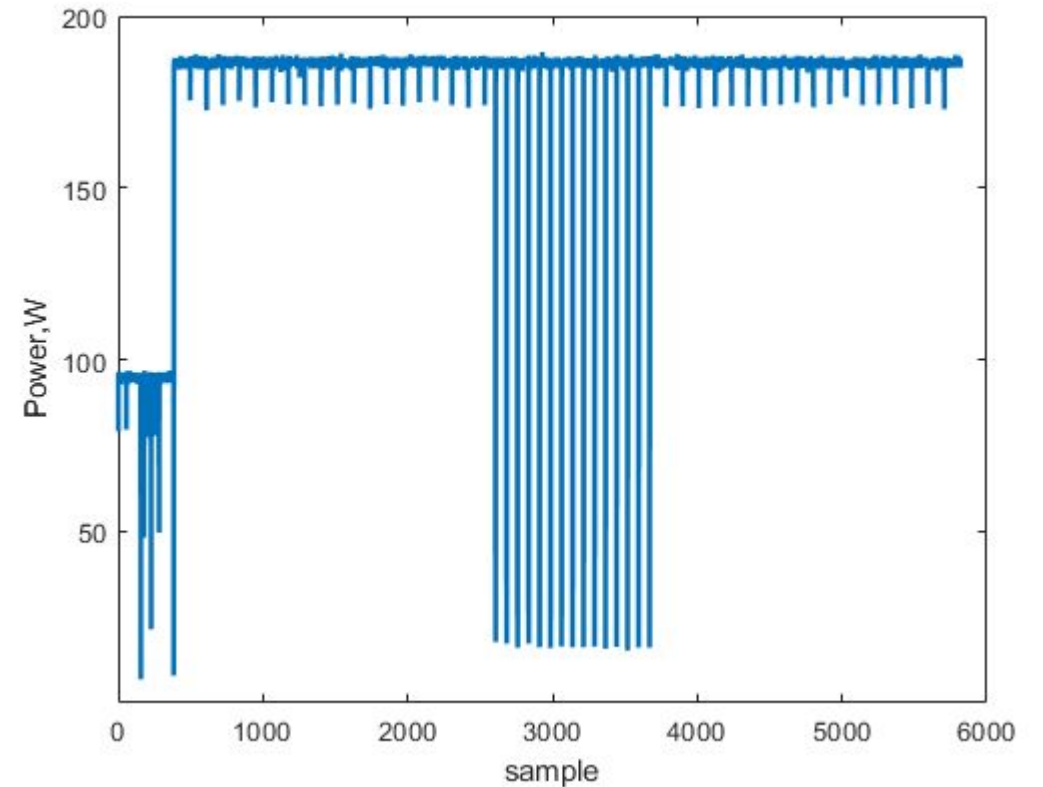
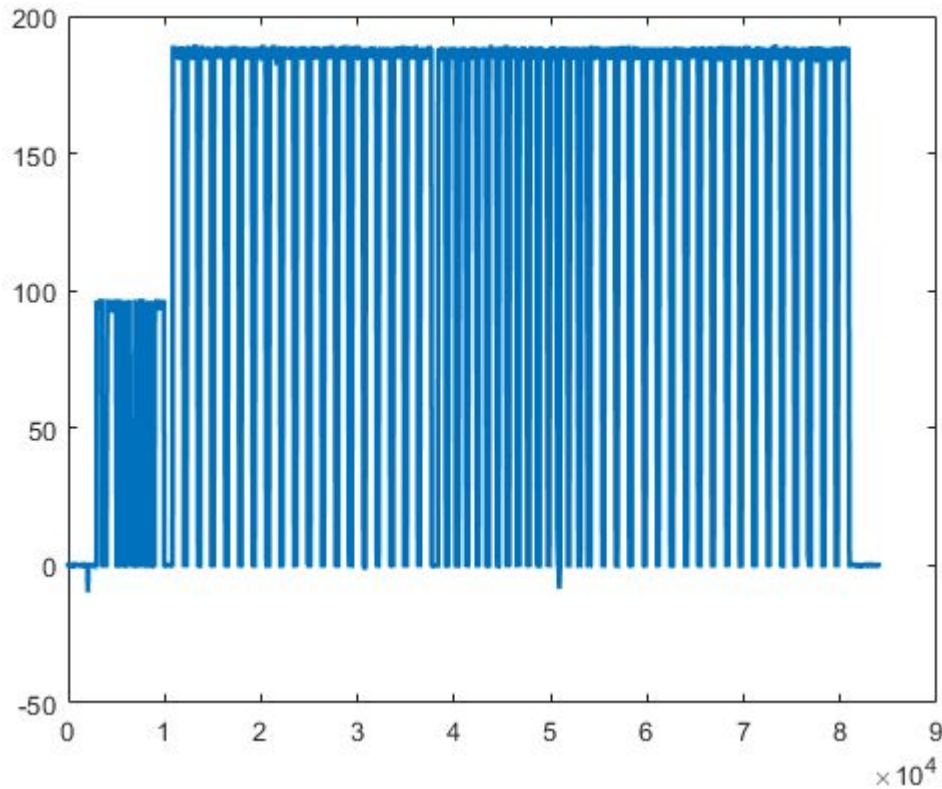
## Result

nominal X,Y and DAQ X,Y that match coaxial image indices



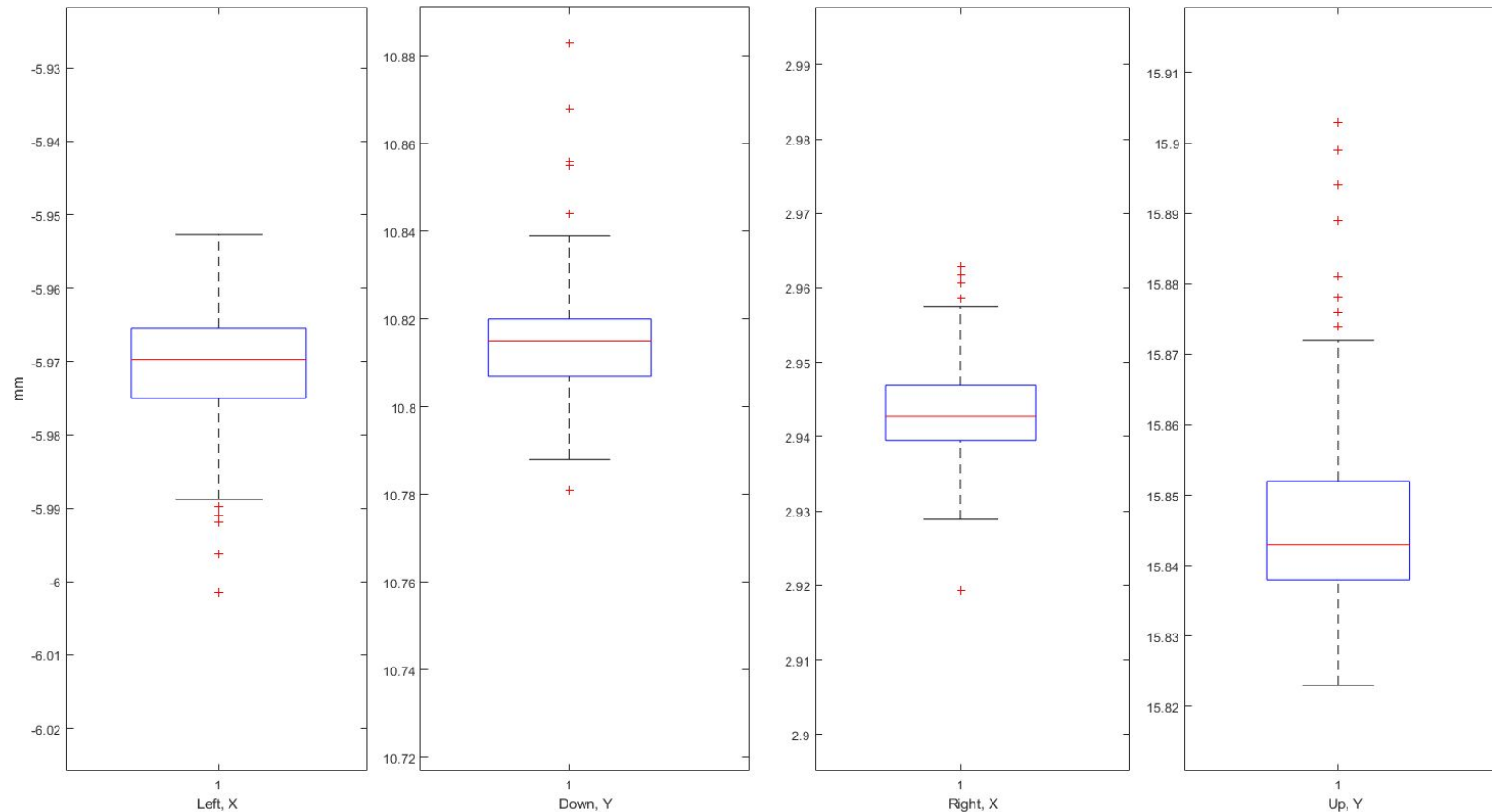


# Approach: coaxial time series preprocessed





# Approach: coaxial coordinates: bounding box

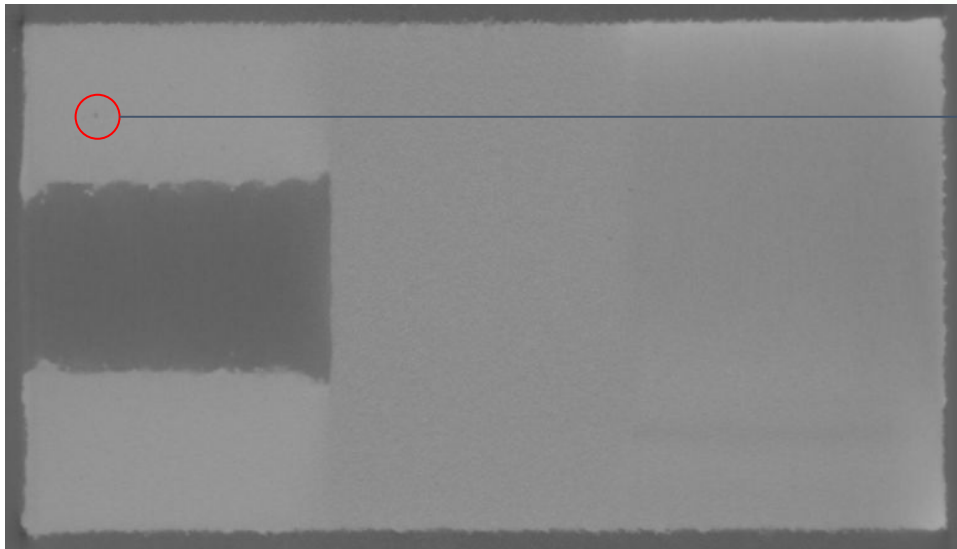




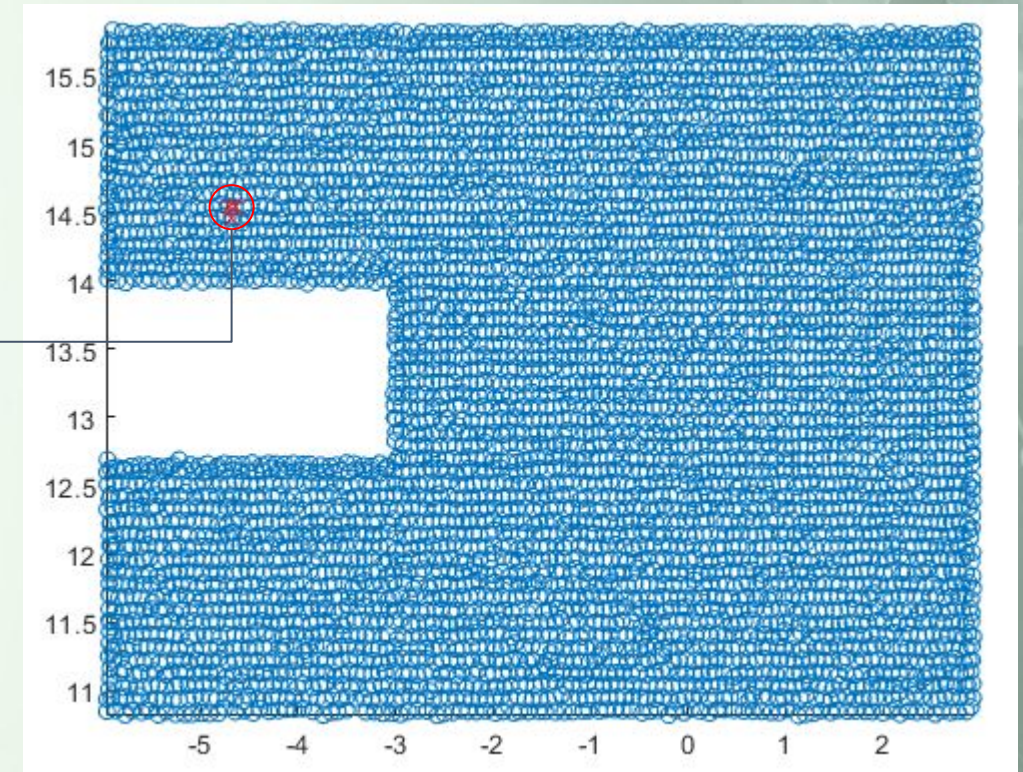


# Results: Mapping locations to coaxial images

- DAQ positions used for matching
  - Filtered out all non-triggered positions



Raw XCT scan image

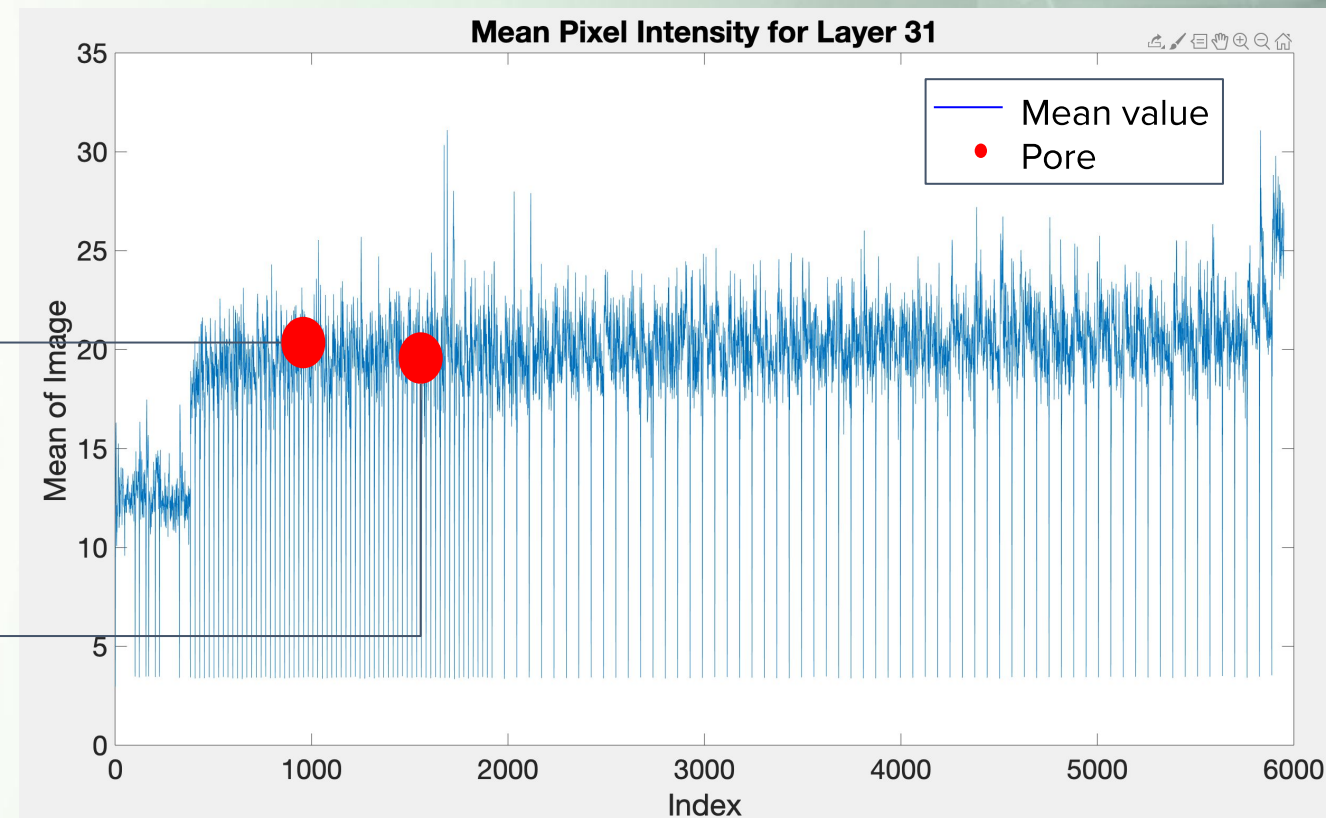
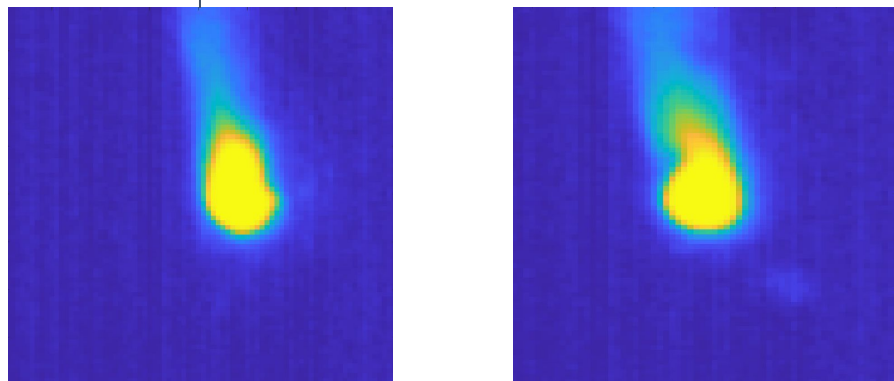


Converted pixel location w.r.t DAQ positions



# Results: Visualization of pore locations w.r.t time

- Mean value of pixel intensity from image
- Coaxial images at pore locations vs. time







## Discussion

- Feasibility evaluation to determine correlation between in-situ data vs. ex-situ XCT scan data
- Synchronization between pore location and position to determine corresponding coaxial image
- Mean value of pixel for coaxial image used as feature to visualize changes throughout process



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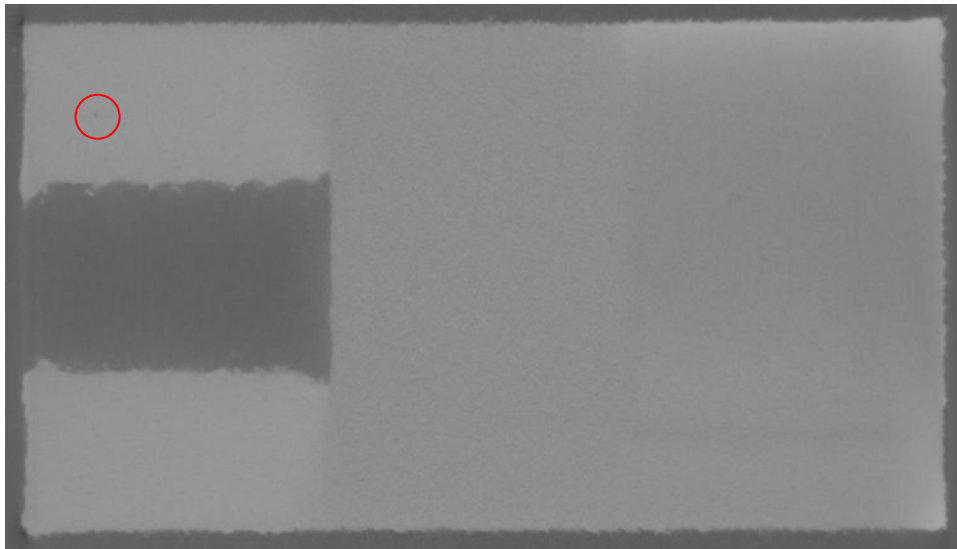
**Thank you!**  
**Q&A**





## Results: Pore location calculation from XCT pixel

- Pore locations selected manually
  - Pixel to actual coordinate conversion done based on spec sheet



Pixel scaling: 0.011953 mm/pixel  
Starting/Ending pixels: (12,11)/(760,430)  
Starting/Ending positions matched with DAQ file:  
(-6.8577,16.9010)/(9.0006/3.7851)