

DVC Challenge Update

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DVC Challenge Objectives

- Characterize DVC error modes with different laboratory XCT equipment
- Establish XCT and DVC “best practices” - what are key experimental parameters that influence DVC accuracy?
- Build DVC research community through collaborative experiments

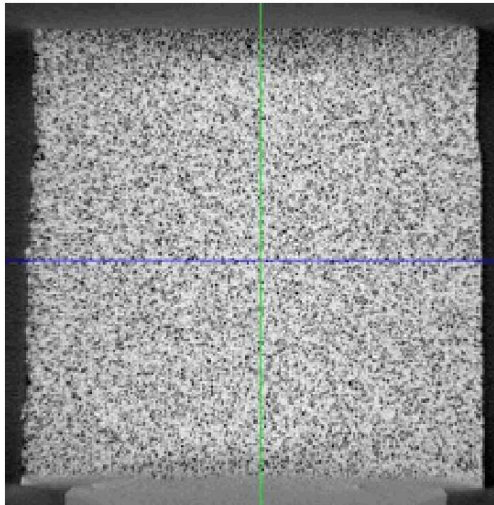
DVC Challenge Overview

- Four participants with laboratory (cone-beam) XCT equipment
- At each lab:
 - Receive GMB/Sylgard syntactic foam specimens (from SNL-CA)
 - Perform *uniform set* of rigid body motion experiments
 - Each lab determines appropriate set of XCT parameters

Experiment Overview

Materials:

- Syntactic foam with ~37% GMBs
- Repeatable manufacturing process – controlled GMB size and porosity
- Previously demonstrated to produce high-quality DVC results [1,2]



Procedure:

- Reference scan
- Repeat motion scans
- Axial motion scans
- Radial motion scans

Scan coordinates (mm):

Scan ID	XCT 1	XCT 2	XCT 3a	XCT 3b
Scan 0 (reference)	(0, 0, 0)	(0, 0, 0)	(0, 0, 0)	(0, 0, 0)
Repeat 1	(0, 0, 0)	(0, 0, 0)	(0, 0, 0)	(0, 0, 0)
Repeat 2	(0, 0, 0)	(0, 0, 0)	-	-
Axial 1	(0, 0, 1)	(0, 0, 1)	(0, 0, 1)	(0, 0, 0.2)
Axial 2	(0, 0, 1)	(0, 0, 1)	-	-
Radial 1	(1, 0, 0)	-	-	-
Radial 2	(1, 0, 0)	-	-	-

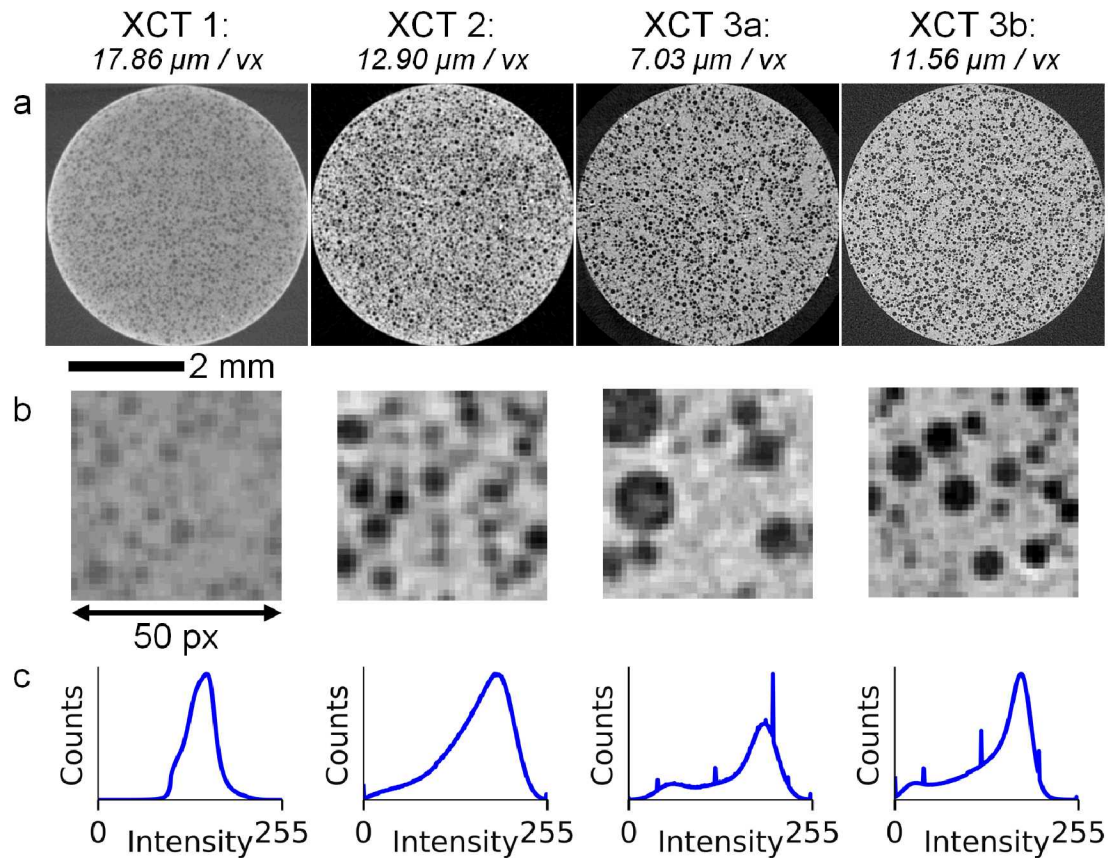
[1] Croom, *Composites Science and Technology*, 2019

[2] Croom, *Experimental Mechanics*, in press

DVC analysis parameters

- “Local” DVC implementation (Vic Volume)
- All analyses are normalized based on voxel size
 - Subset size, step size, strain filter are scaled based on voxel size

Preliminary Results



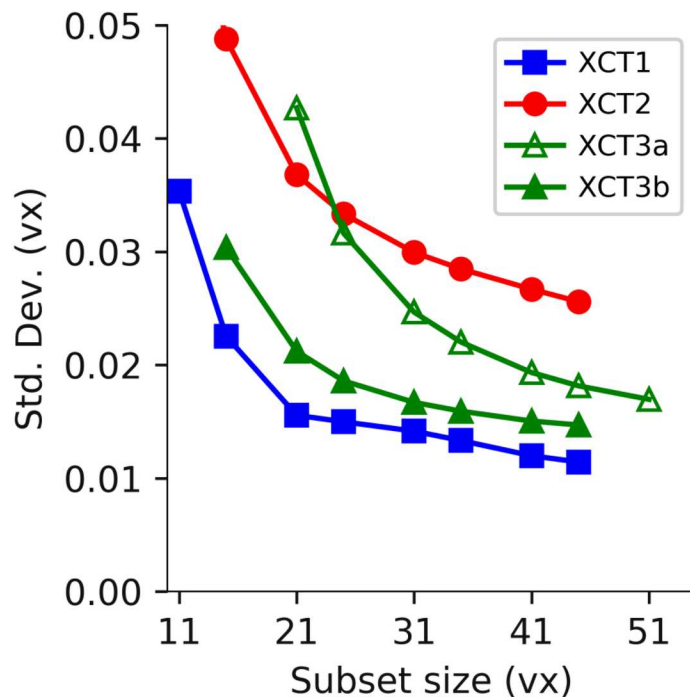
Preliminary Results

Repeat scans:

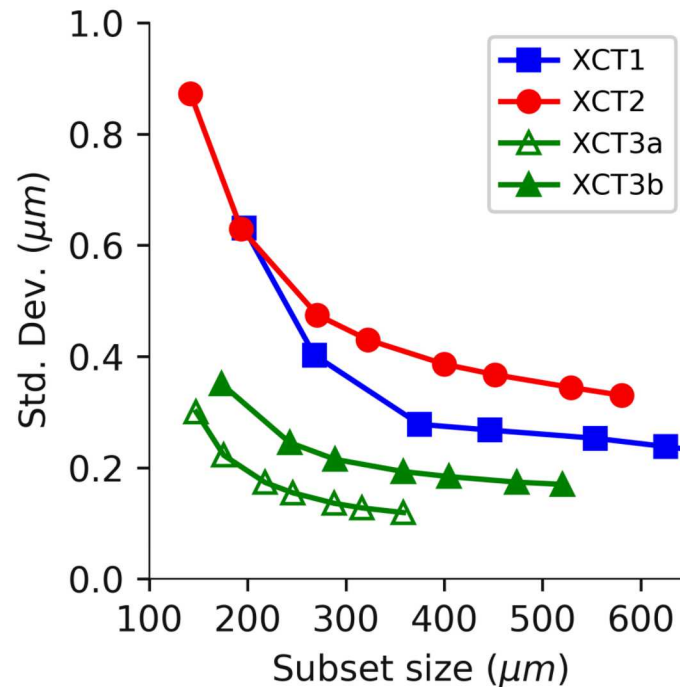
Y-direction displacement *noise*

(noise = St. Dev. of artificial displacements)

Noise in voxels:



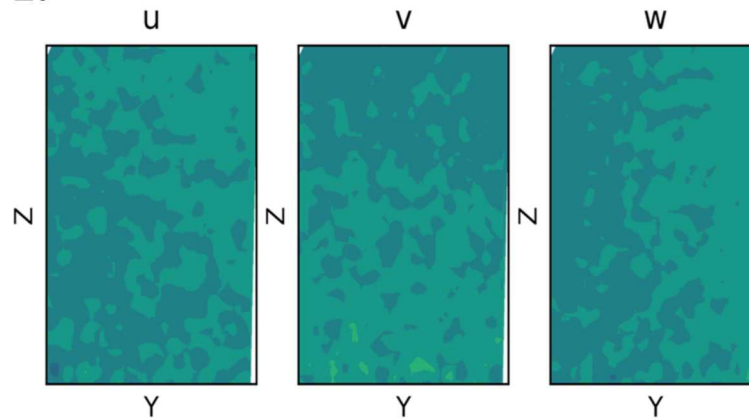
Noise in μm :



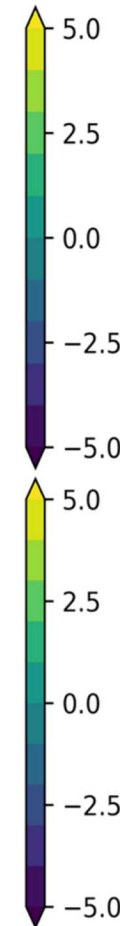
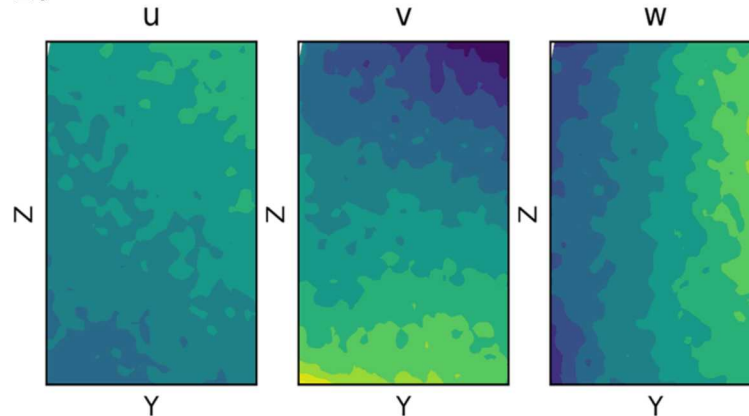
Preliminary Results

XCT systems have unique systematic error profiles

XCT 1:



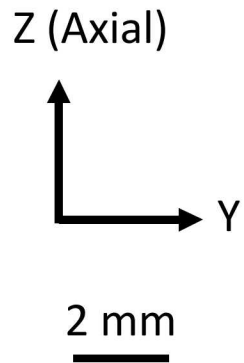
XCT 2:



Artificial displacement (μm , rigid translation subtracted)

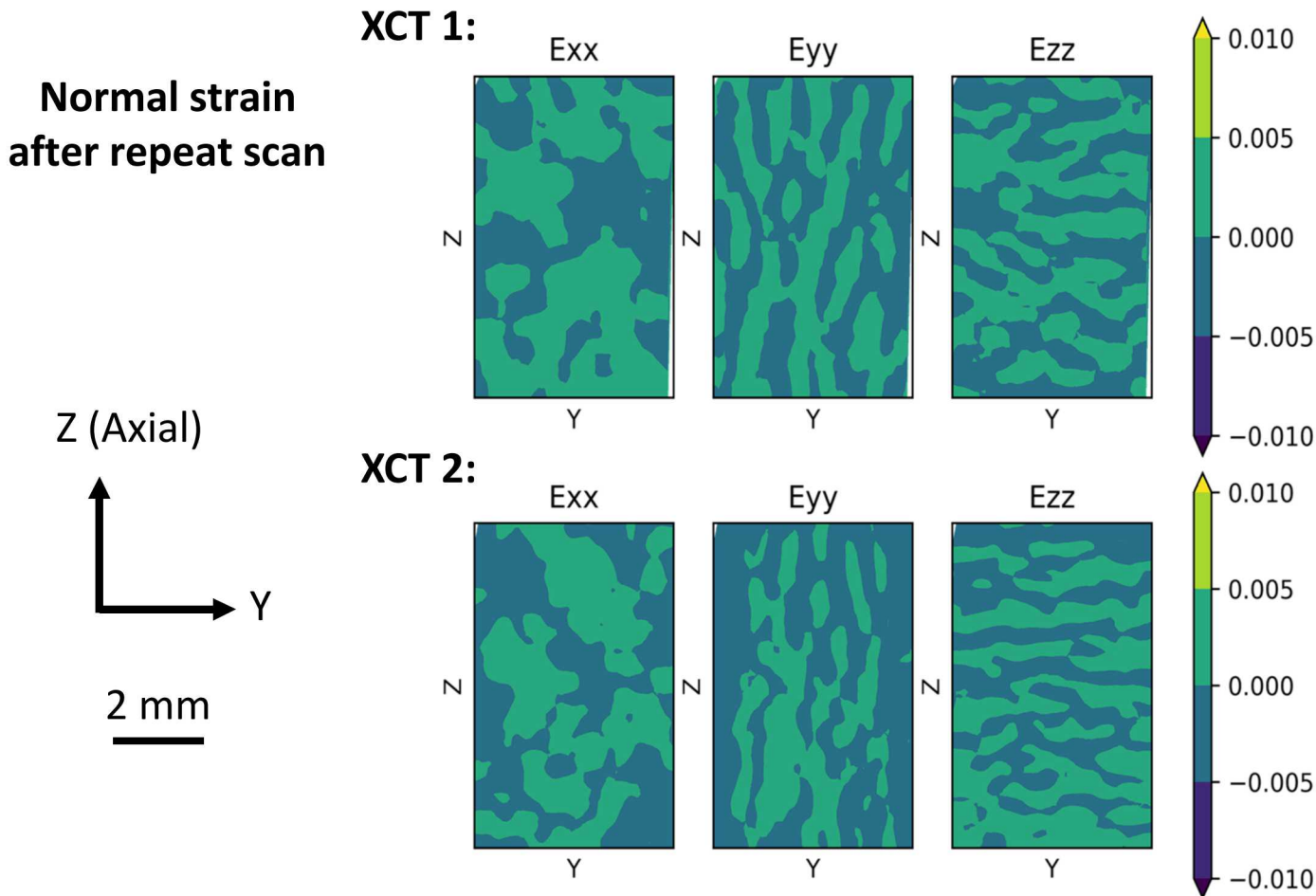
Artificial displacement (μm , rigid translation subtracted)

Displacement after repeat scan



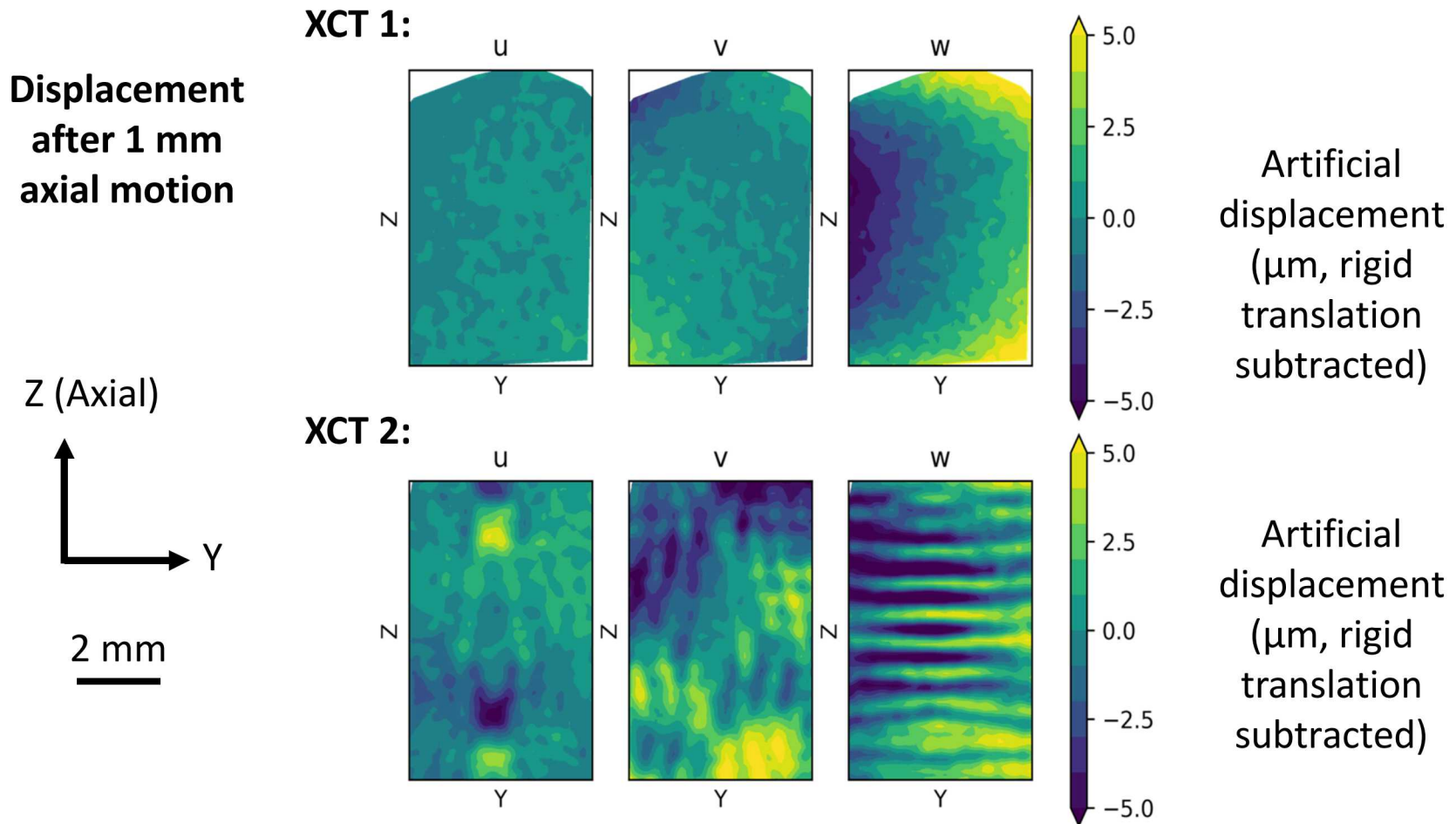
Preliminary Results

XCT systems have unique systematic error profiles



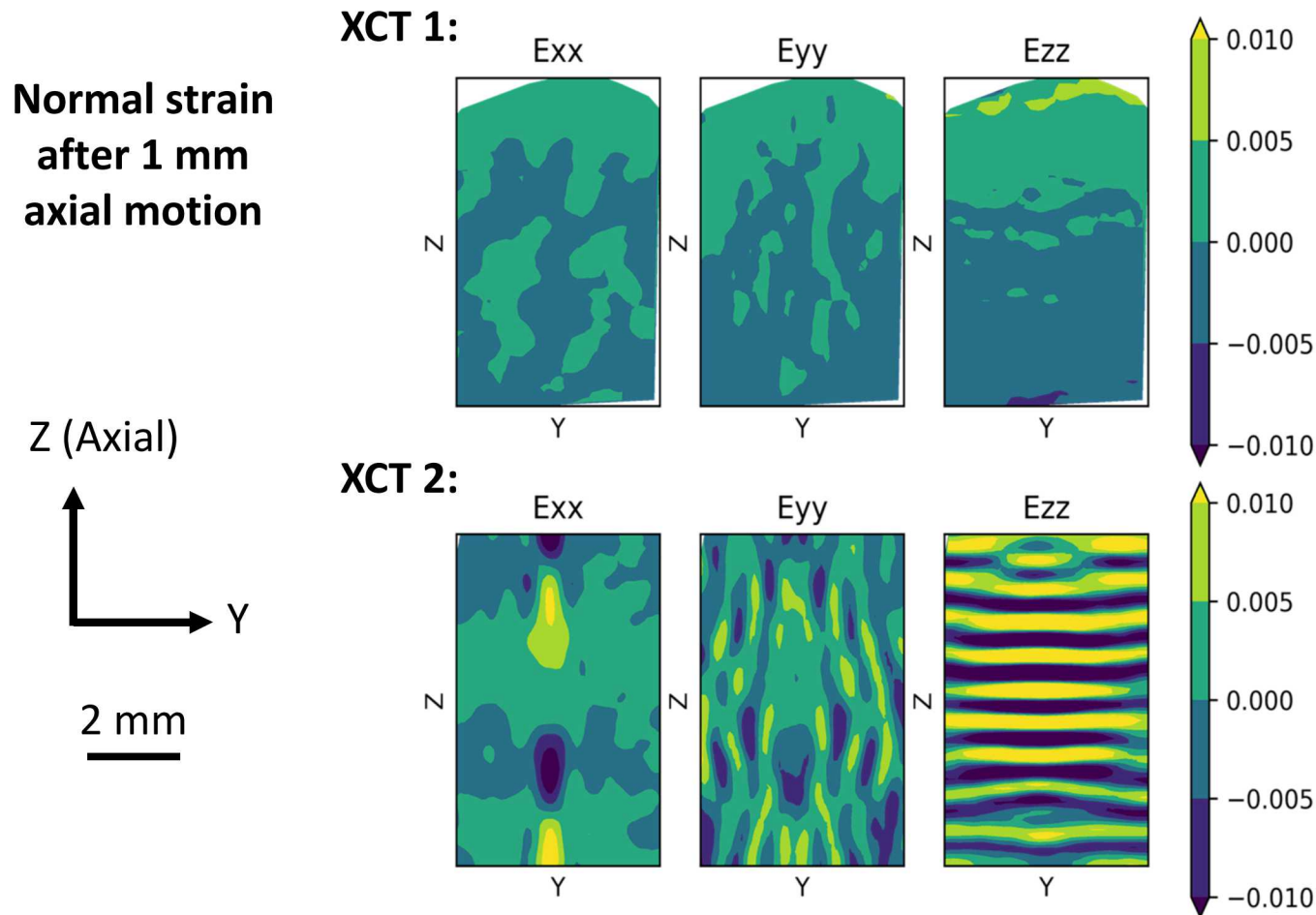
Preliminary Results

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Preliminary Results

XCT systems have unique systematic error profiles



Ongoing work

- Waiting on data from 4th laboratory participant (XCT4)
- Manuscript in progress – submit by fall?