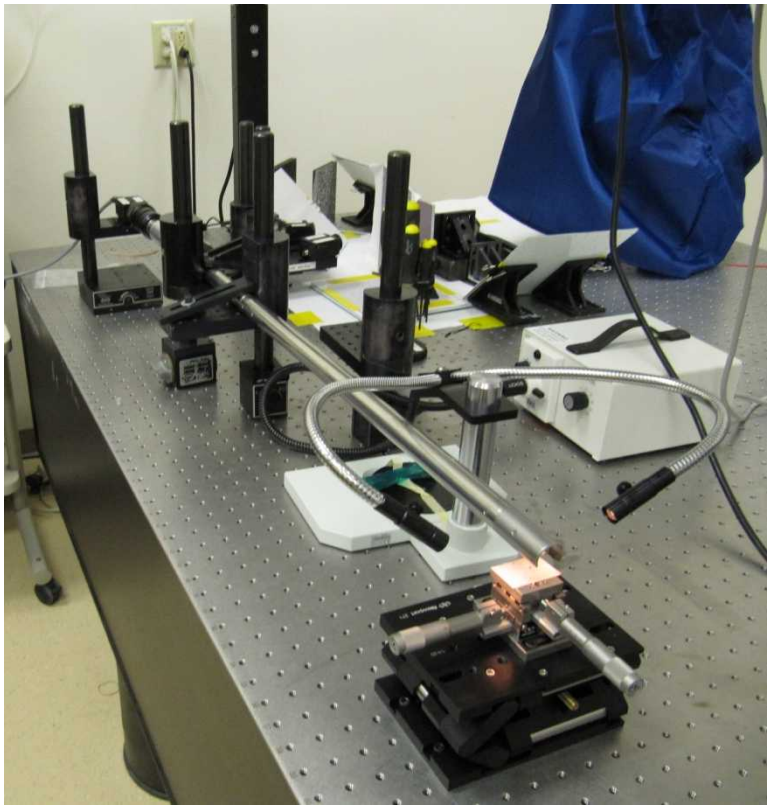
DIC through a rigid borescope

SAND2011-3933C



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Senior Member Technical Staff

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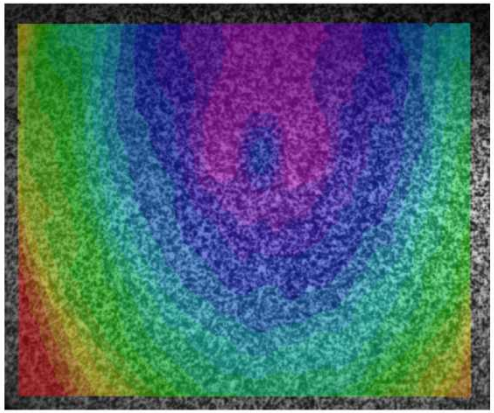
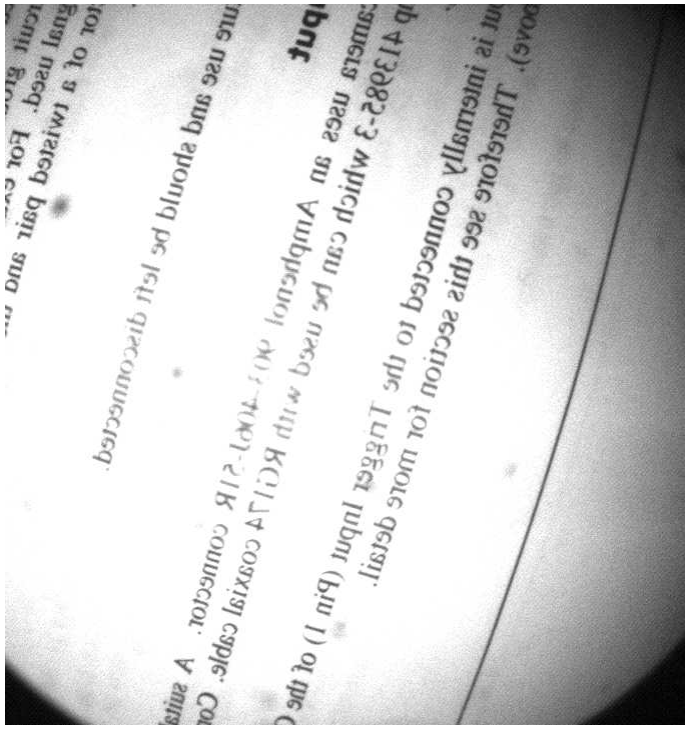
Quantifying and removing the distortions is critical

Experimental Setup



Optical Distortions



Imaging Through a Borescope

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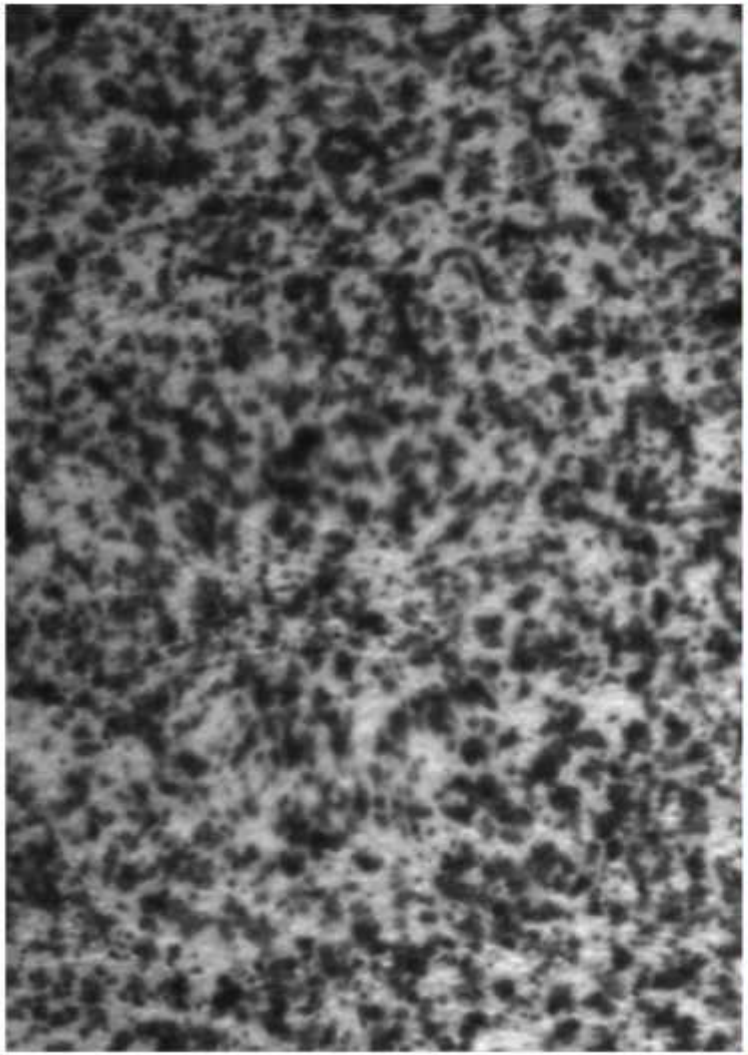
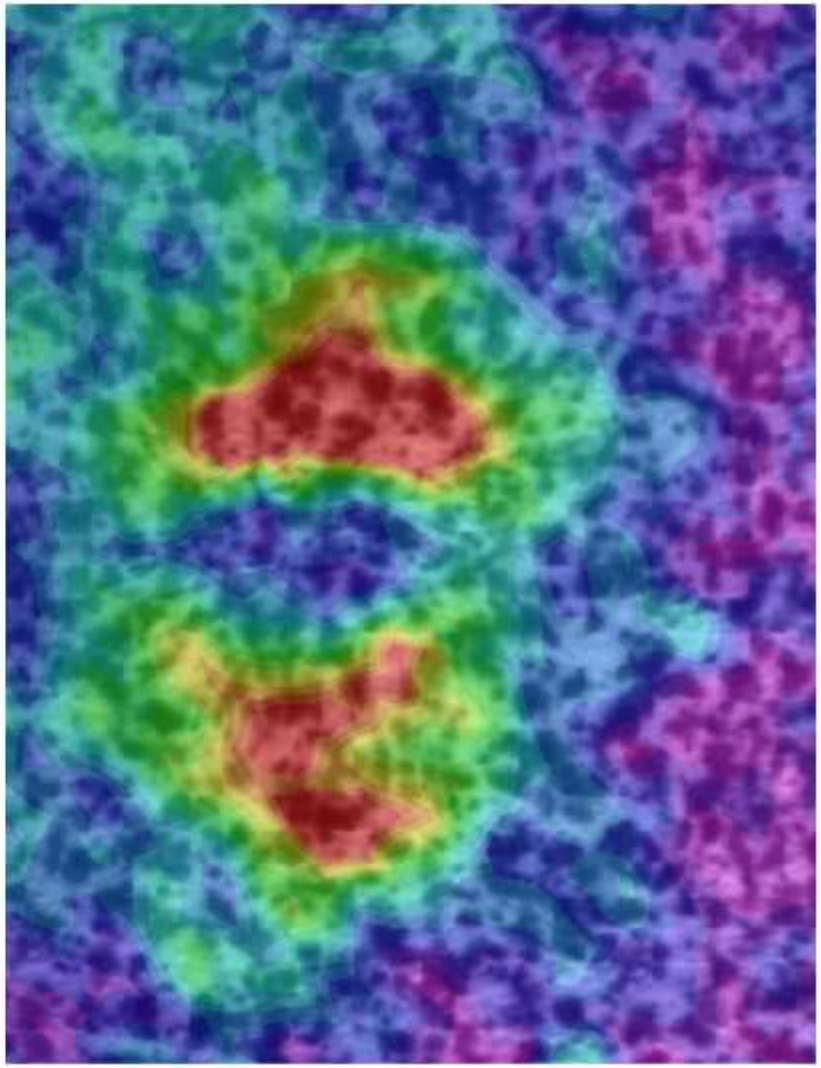
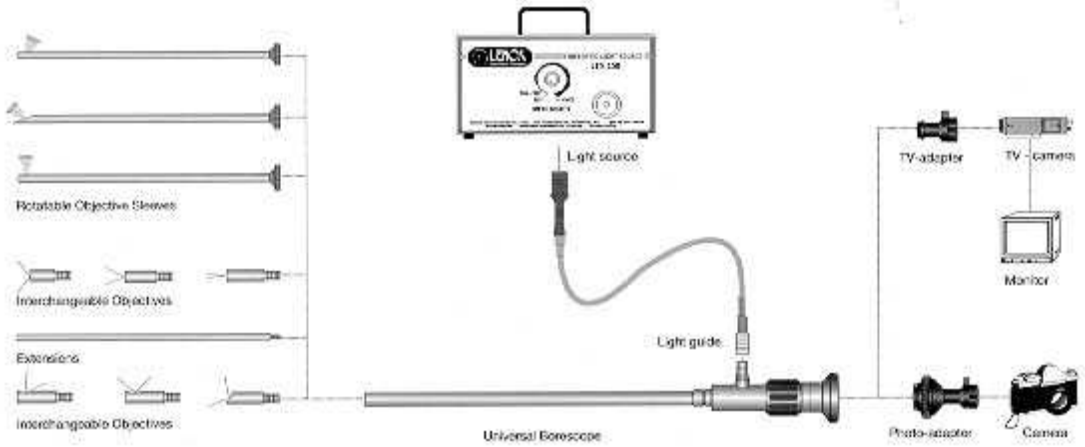
The lens distortions can be seen by looking at the images

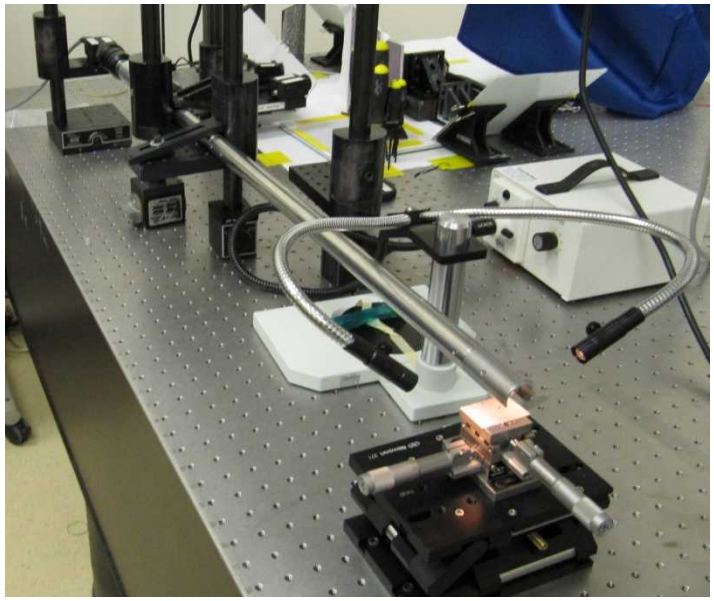




A Lennox rigid sectional borescope was used for testing



- 15/16 inch diameter
- 1-meter length for short section
- 2.8 meters full-length for these tests
- Extendable beyond 6 meters

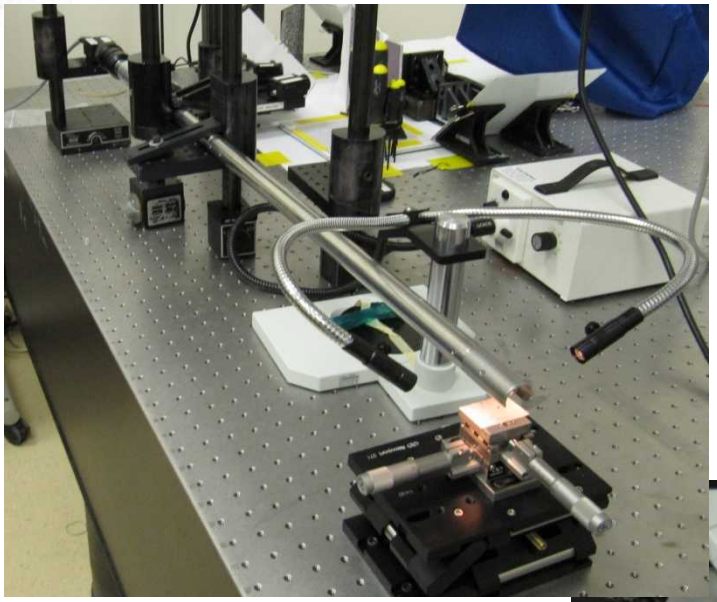


Issues with the Setup

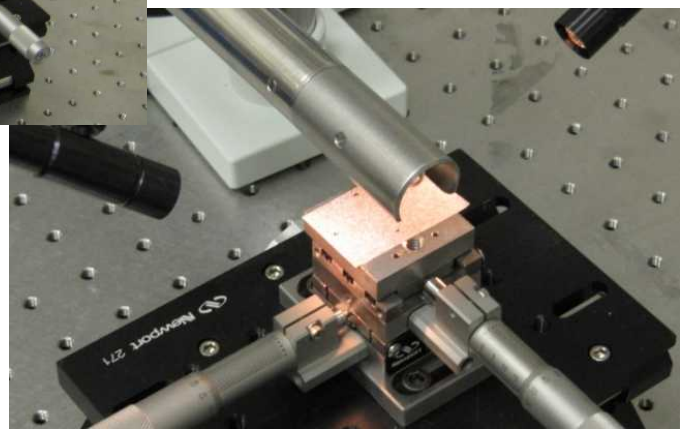
1. Camera mounting was for a 1/3” CCD chip. This created vignetting.
2. All the lenses were dirty!
3. There was a lens issue in the last segment.

The experimental setup used a 5-MP camera with a 75-mm relay lens

A 75-mm lens was used to relay the image from the eyepiece to the camera detector.



FOV = 20 mm



A stage is used to make controlled translations for distortion correction.

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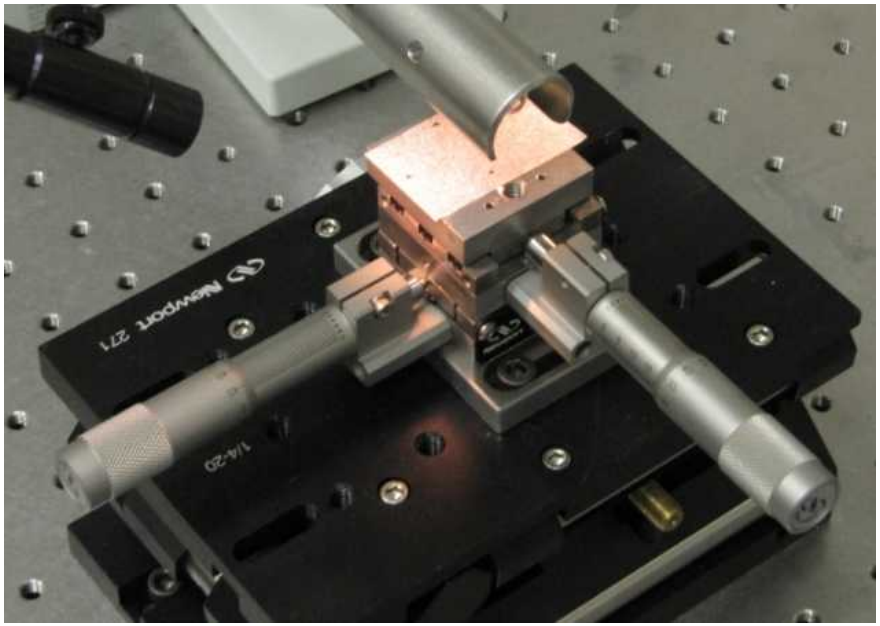
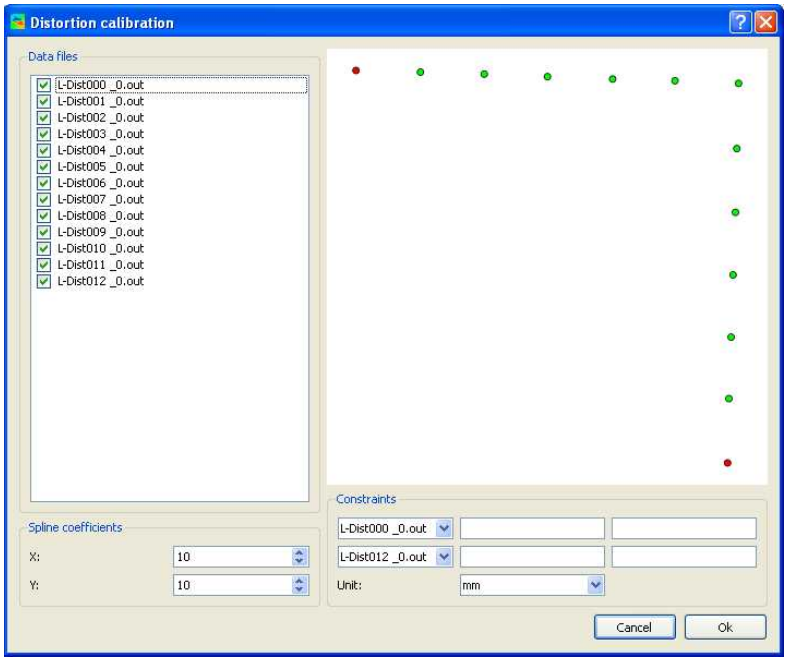
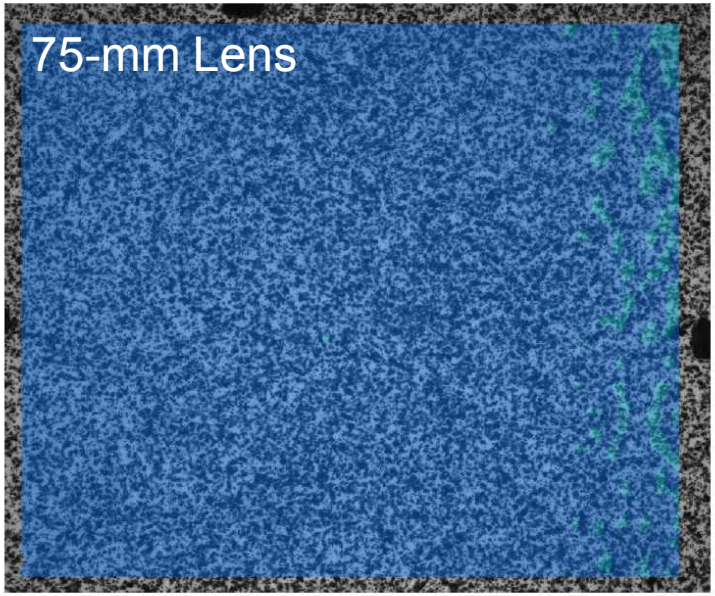
Controlled in-plane translations are required to correct the distortions

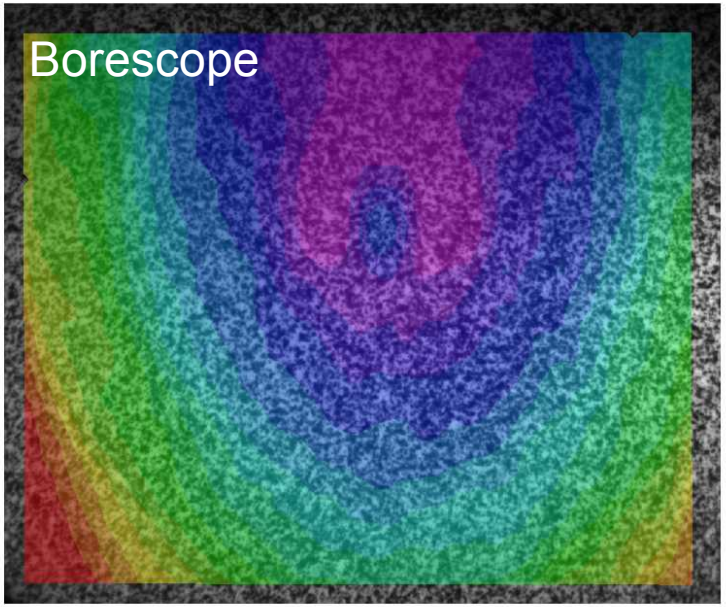


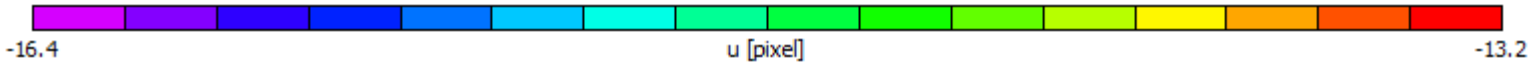


- The flat and rigid speckle pattern were translated 0.3 mm in perpendicular directions.
- The software fits a spline function (10 coefficients) to remove the distortions and scale the results.

The uncorrected distortion with 0.3 mm translation was ± 3 pixels







Displacement (pixels)

Similar magnitudes in the y-direction

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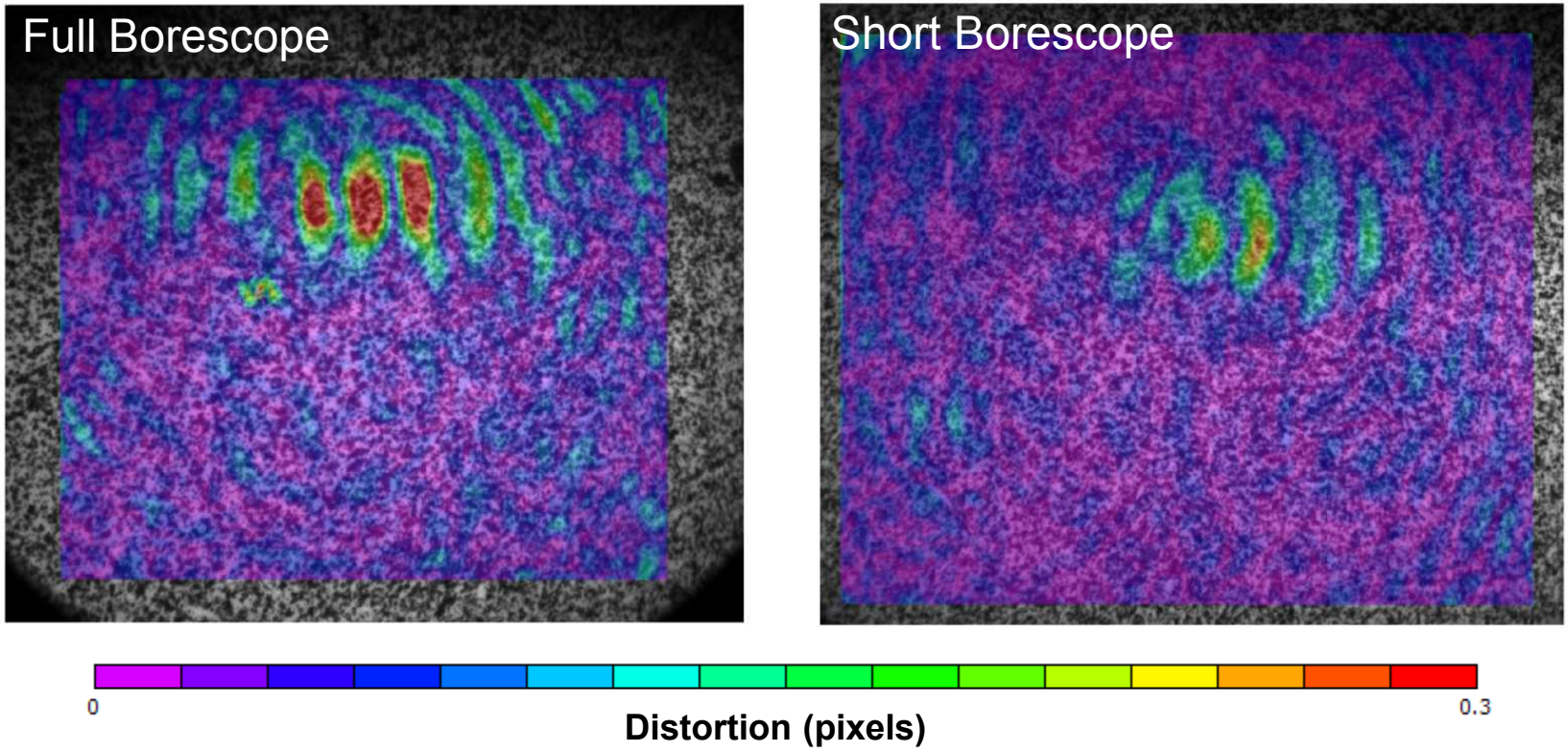
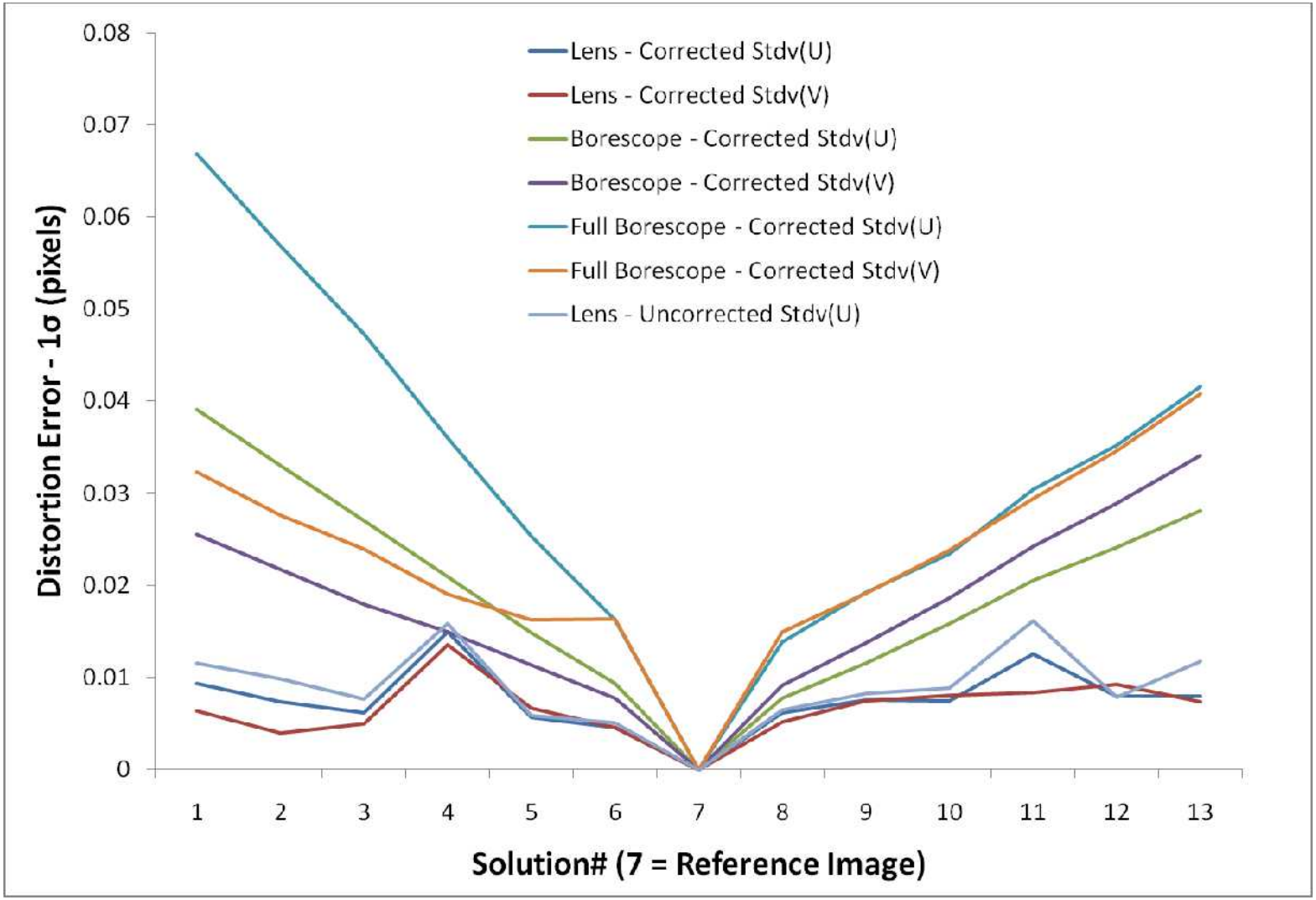
The distortions can be greatly improved… ± 0.3 pixels



The correction for the borescope is not complete. Errors still remain.



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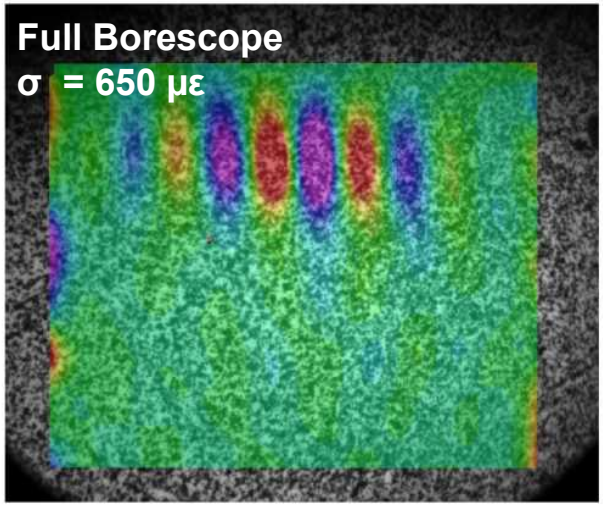
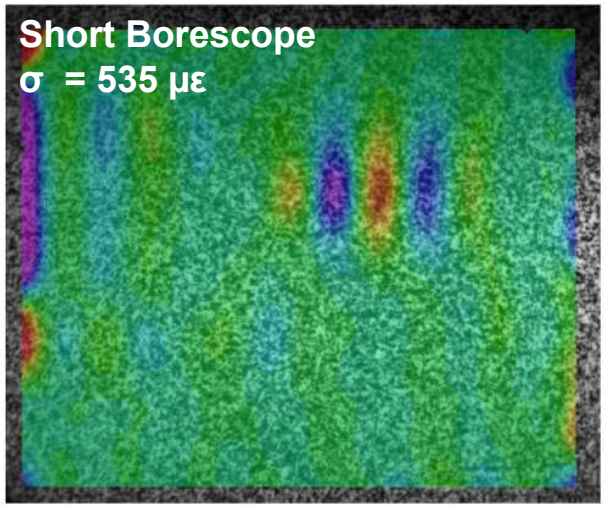
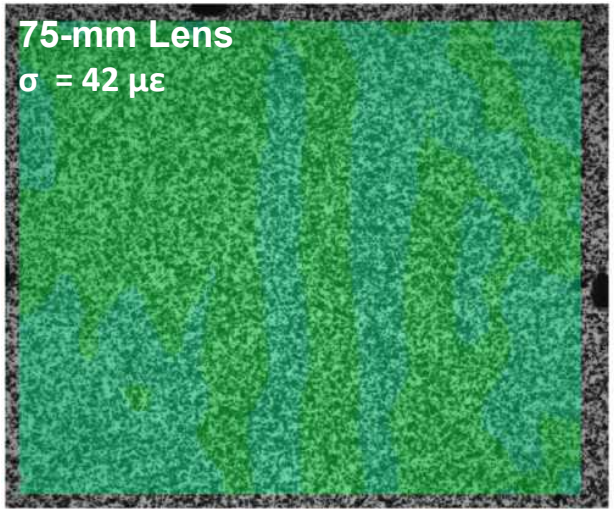
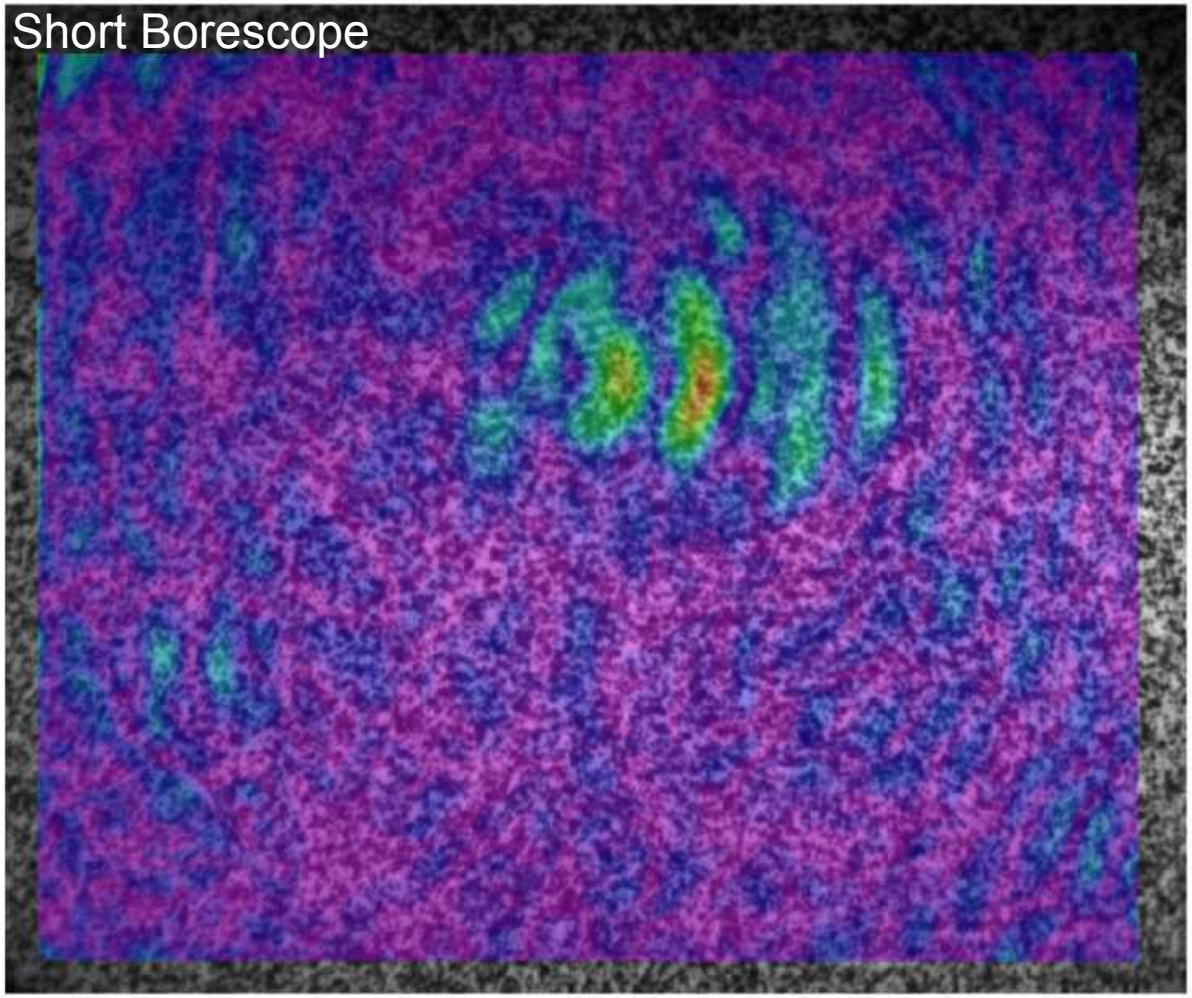
The strain errors are relatively large due to the local nature of the distortions







A better borescope would need to be built to do DIC!



Questions?