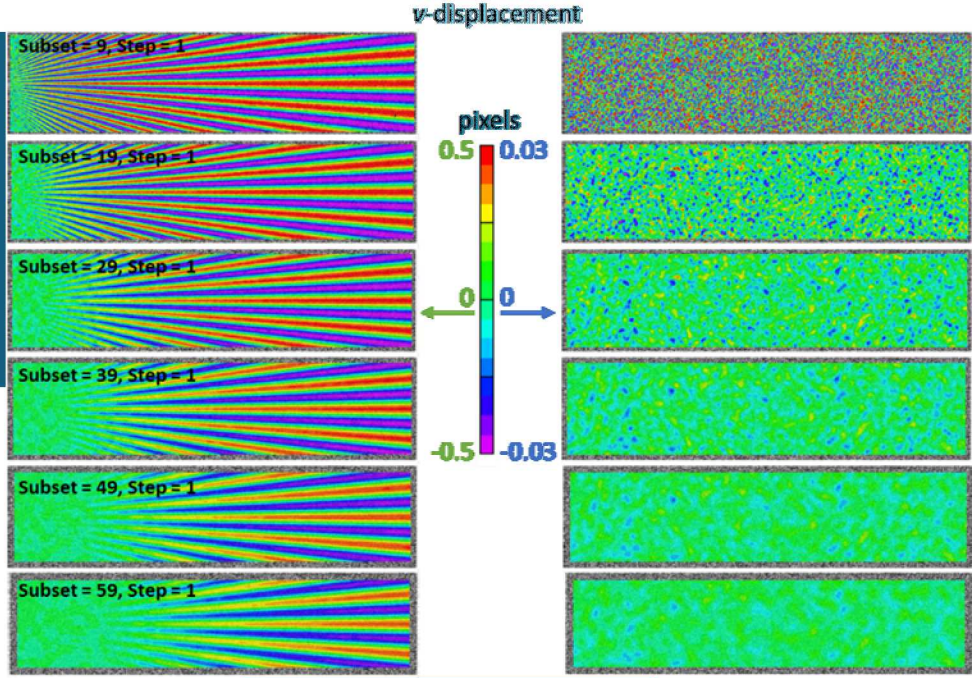
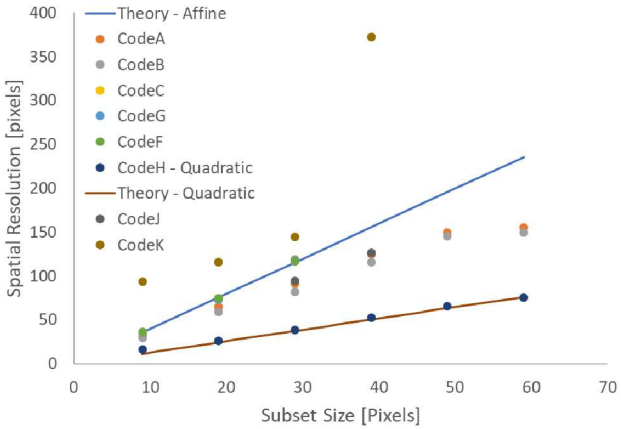
SAND2019-5982C

Update on the DIC Challenge 2.0 and the Stereo-DIC Challenge





PRESENTED BY

Phillip Reu, Benoît Blaysat, Elizabeth Jones, Jeff Helm, and Mark Iadicola

Sandia National Laboratory

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DIC Challenge Mission: Provide standardized image sets for DIC code verification and validation.

DIC Challenge (*https://sem.org/dic-challenge*)

- International DIC board of experts developing image sets to be used for verification and validation of DIC codes.
- No ties to commercial or university codes
- Open and free to participate
- Code developers do their own analysis to ensure "optimum" results.
- Benchmarked results provided for all to see
- Proven image sets provided for **Journal Publications**
- Standard images to test **improvements** in DIC code.

iDICs INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

DIC Board Members

- Phillip Reu (Sandia) – Chair
- Mark Iadicola (NIST) – co-chair
- Helena Jin (Sandia) – DVC Challenge Lead
- Will LePage (Univ. of Michigan) – SEM Lead
- Benoît Blaysat (Univ. Clermont Auvergne) – Lead 2D Challenge 2.0
- Elizabeth Jones (Sandia)
- Evelyne Toussaint (Univ. Clermont Auvergne)
- Hugh Bruck (University of Maryland)

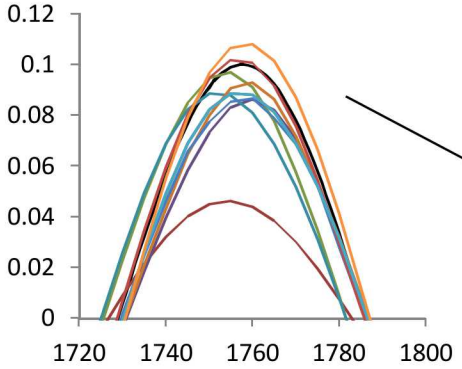
DIC Challenge 1.0 is Published

Reu, P. L., et al. (2017). "DIC Challenge: Developing Images and Guidelines for Evaluating Accuracy and Resolution of 2D Analyses." Experimental Mechanics.

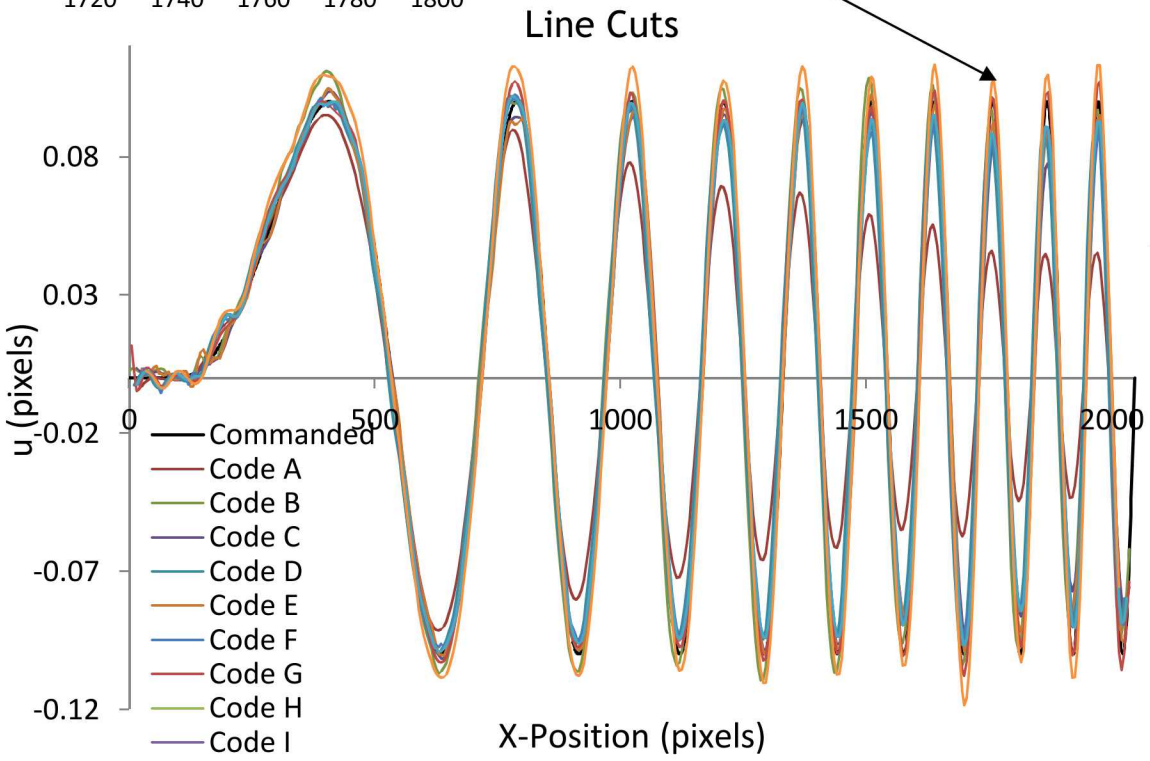
Why the 2D Challenge 2.0? Testing spatial resolution.

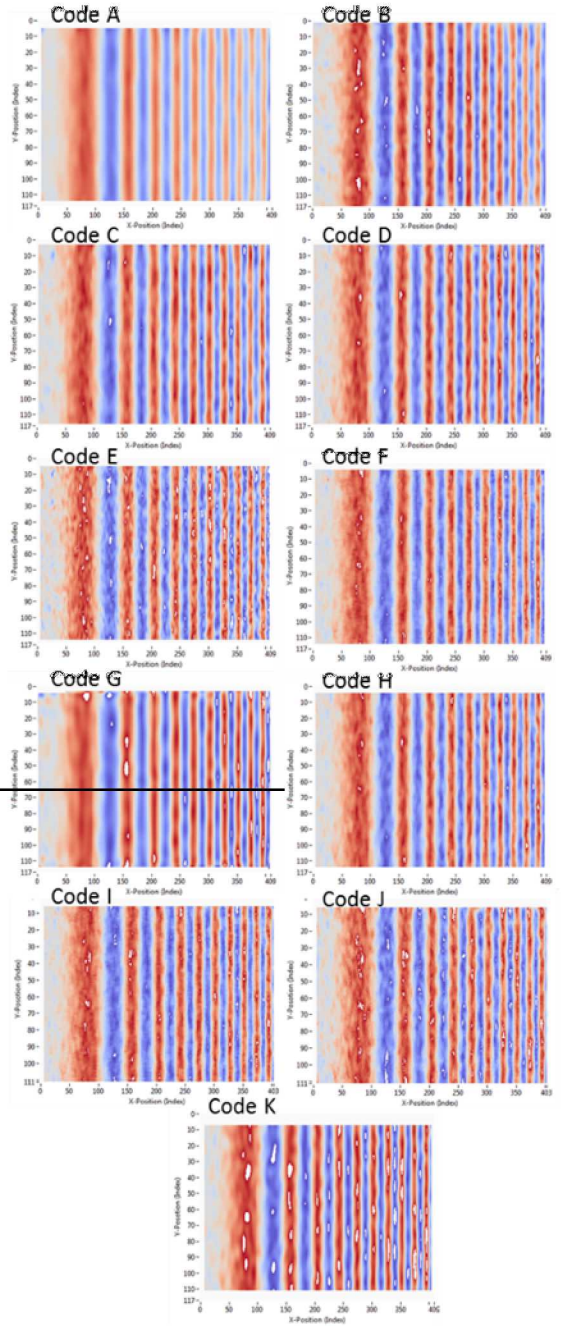
Spatially varying sine wave

- Amplitude ±0.1 pixels
- Results in varying strain amplitude

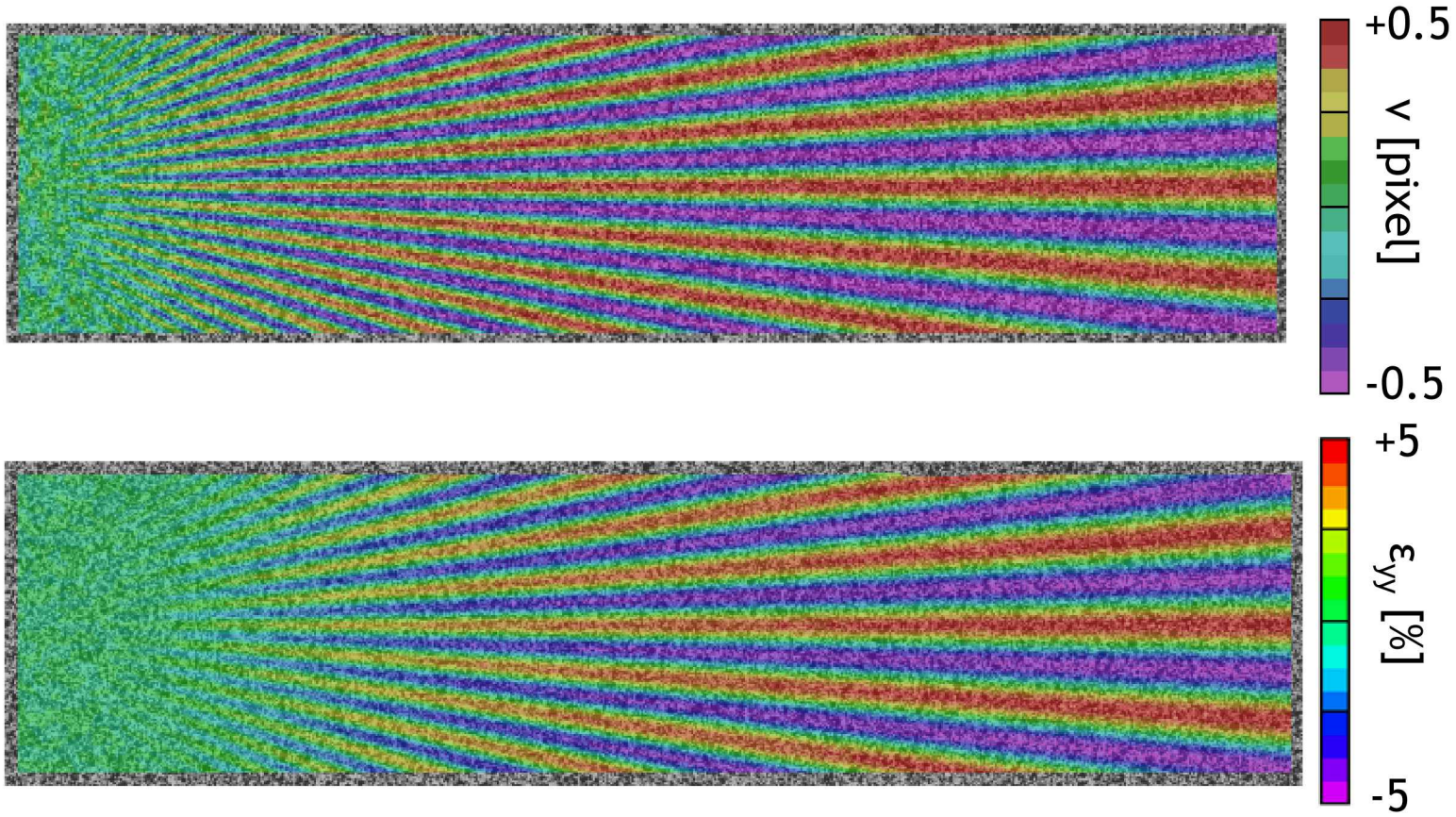


Spatial resolution is the ability to represent a spatially varying displacement or strain field.



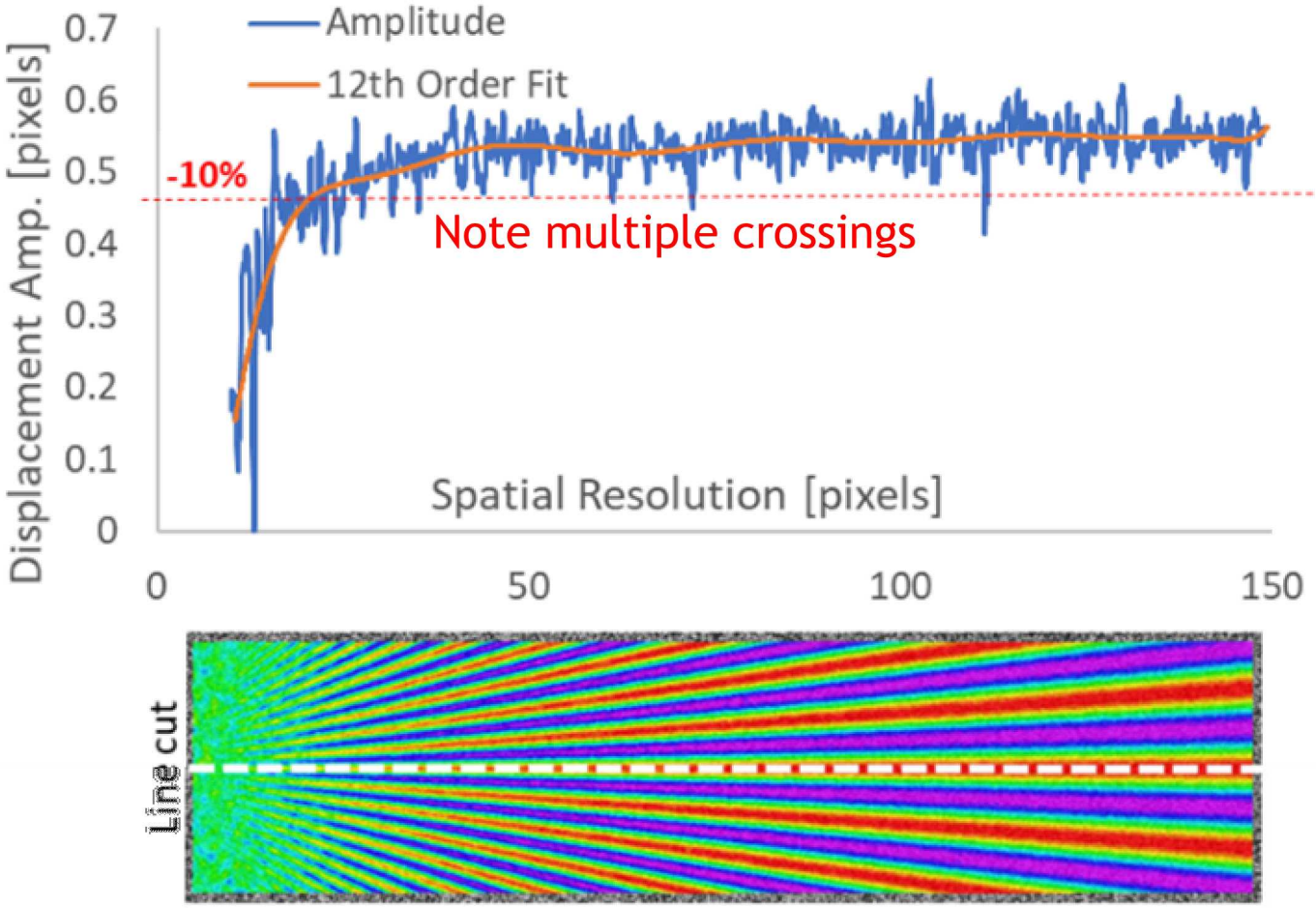


2D DIC Challenge Images are designed to test spatial resolution in a single image.

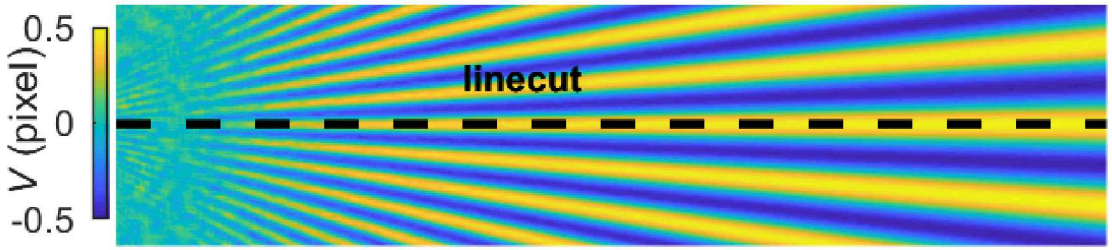


- Grediac, M., et al. (2017). "A Critical Comparison of Some Metrological Parameters Characterizing Local Digital Image Correlation and Grid Method." Experimental Mechanics **57(6): 871-903.**
- Sur, F., et al. (2017). "Rendering Deformed Speckle Images with a Boolean Model." Journal of Mathematical Imaging and Vision.

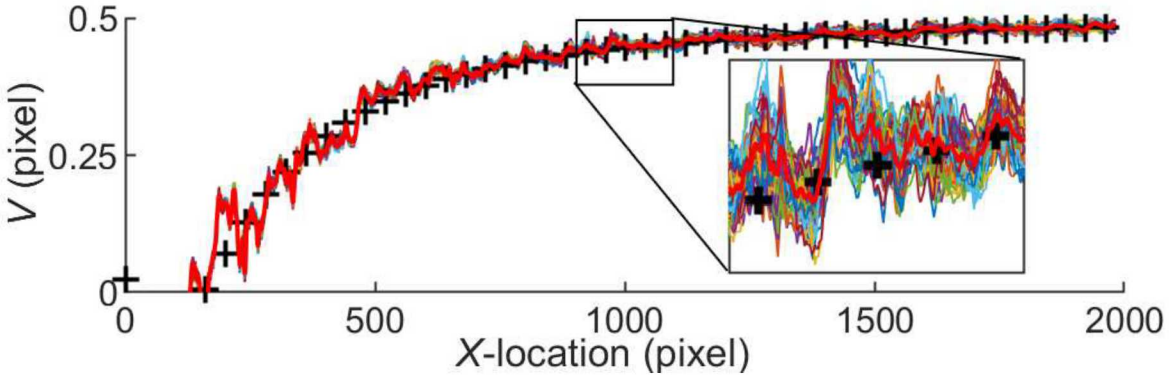
The spatial resolution is calculated using a fit to a 12th order polynomial and finding the 10% attenuation.



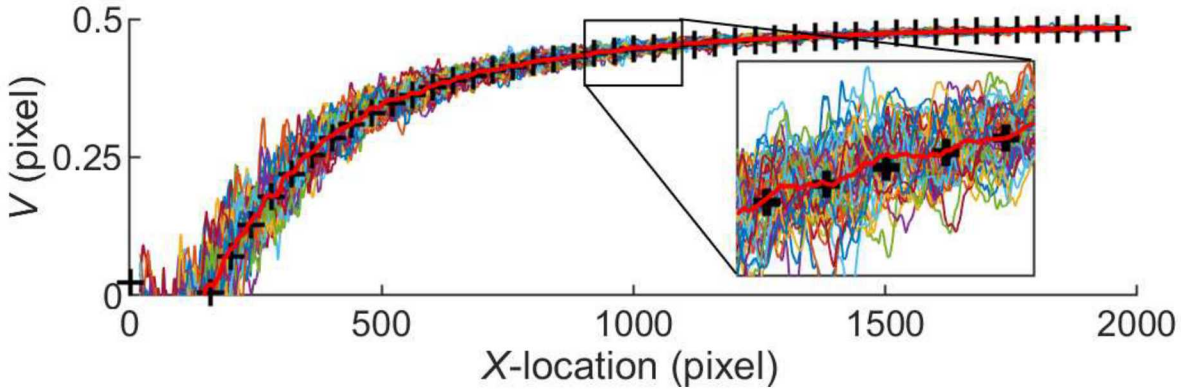
Pattern Induced Bias (PIB) – Requires fitting to find the cut-off frequency



Independent heteroscedastic noise

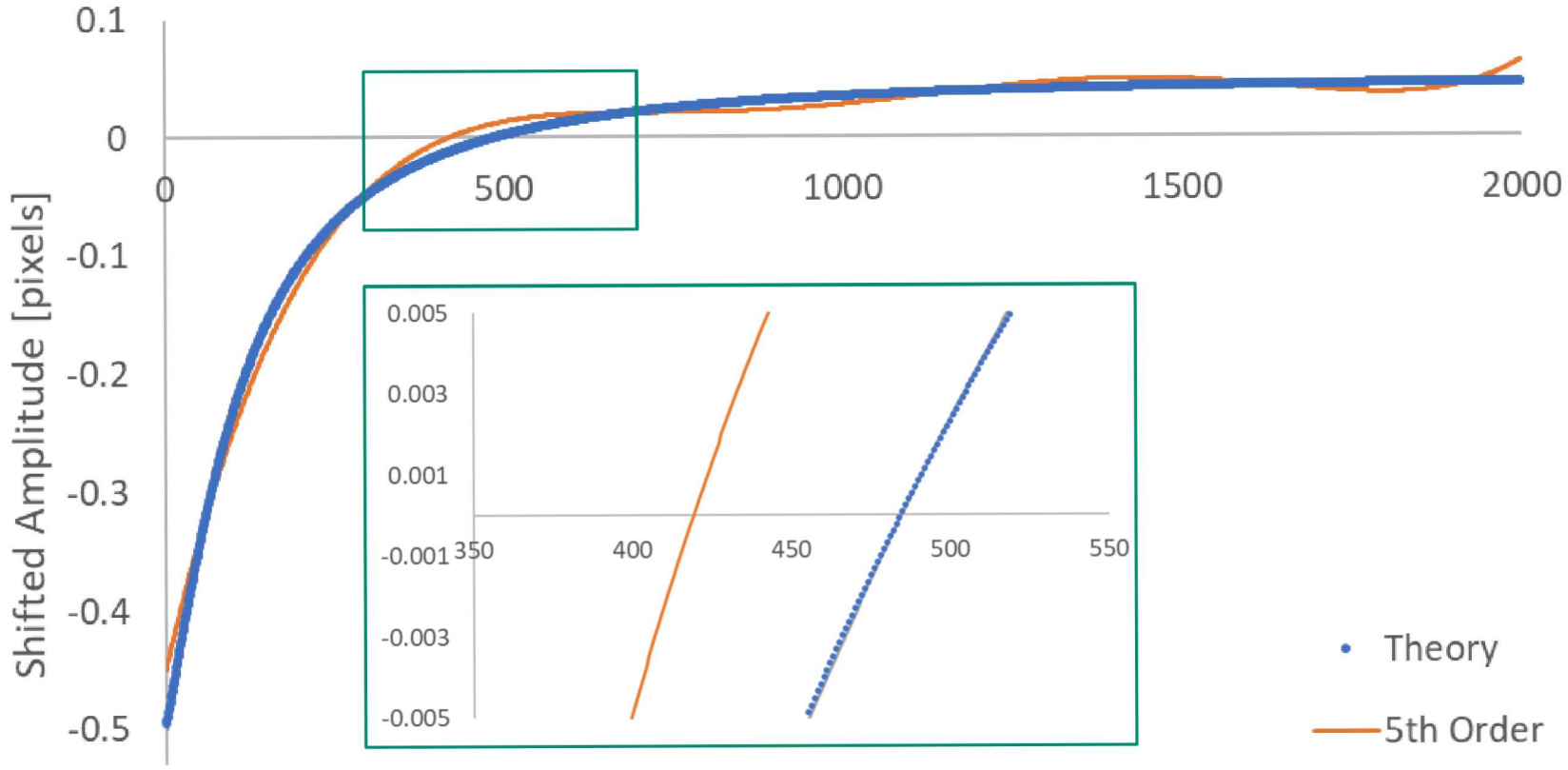


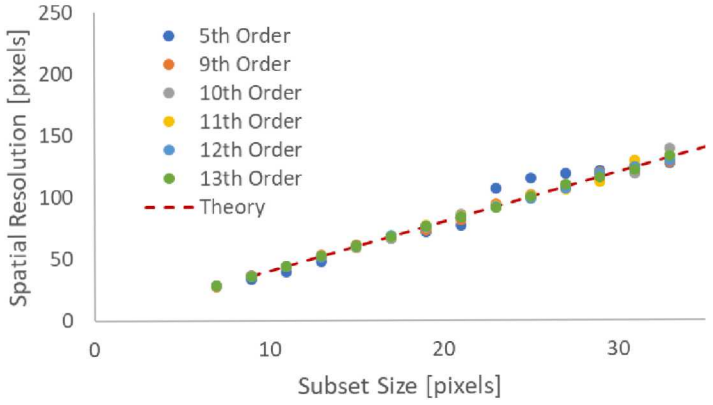
Independent unique patterns



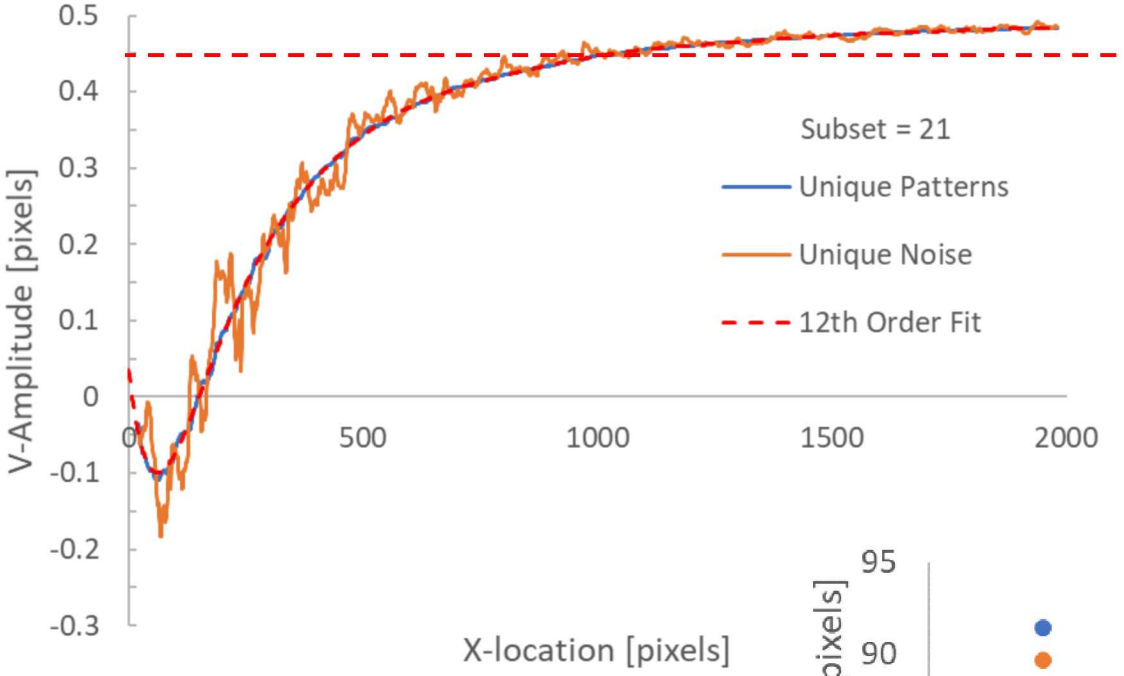
Stay for the next talk!

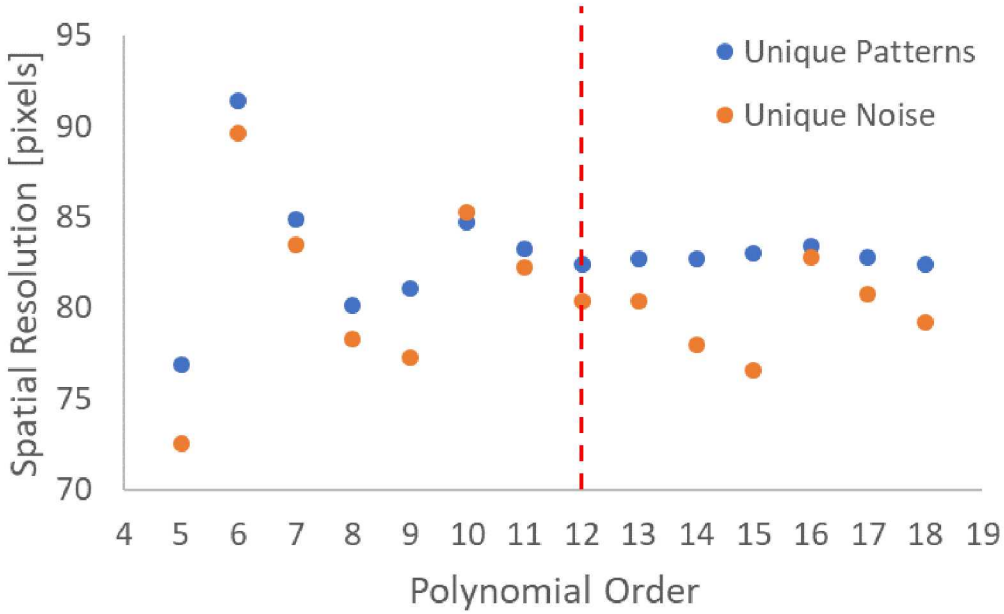
12th Order provides a good fit relative to the theory, without overfitting.



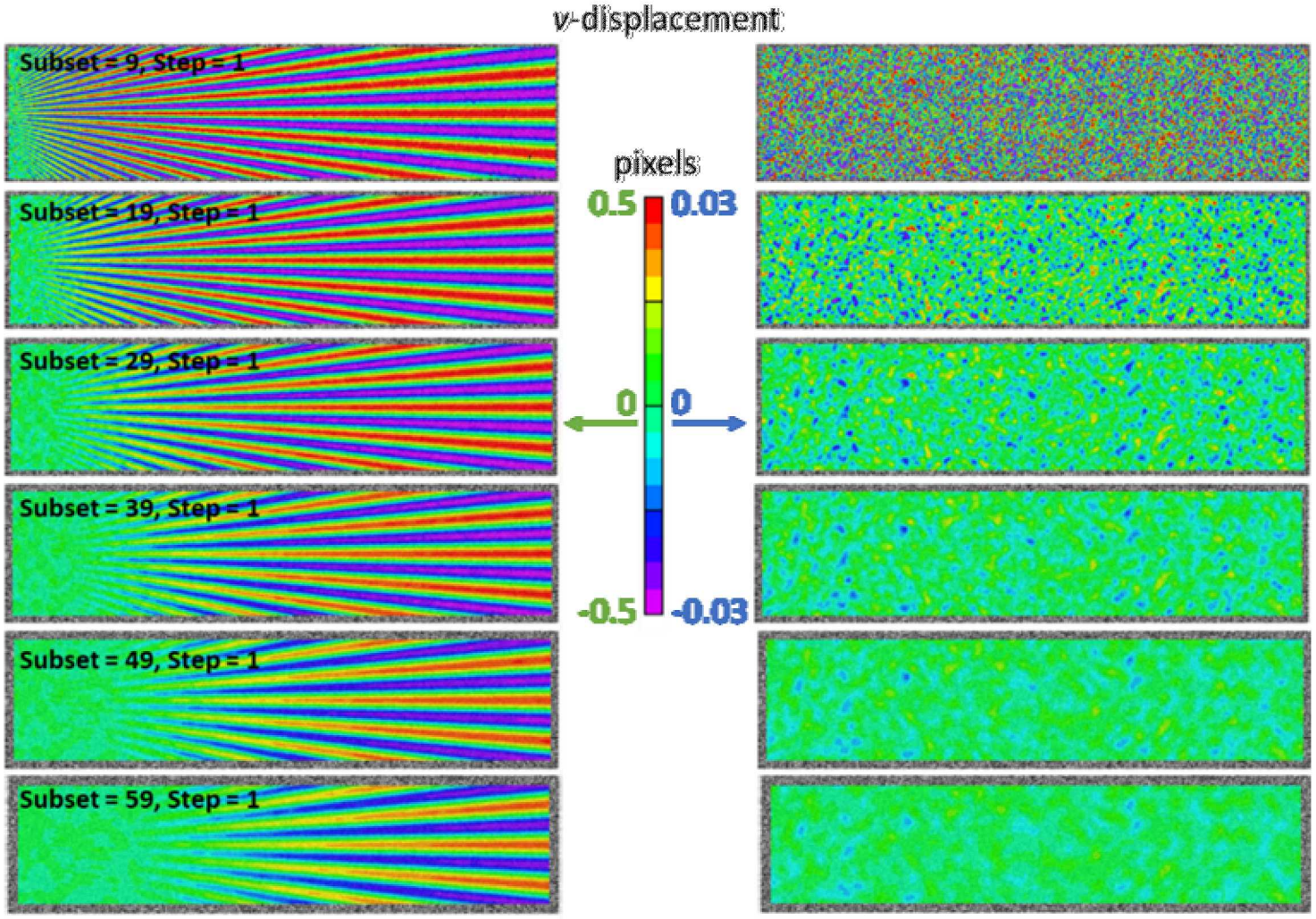


Using the PIB unique-pattern averaged DIC result to eliminate PIB error, the 12th Order Fit is good.



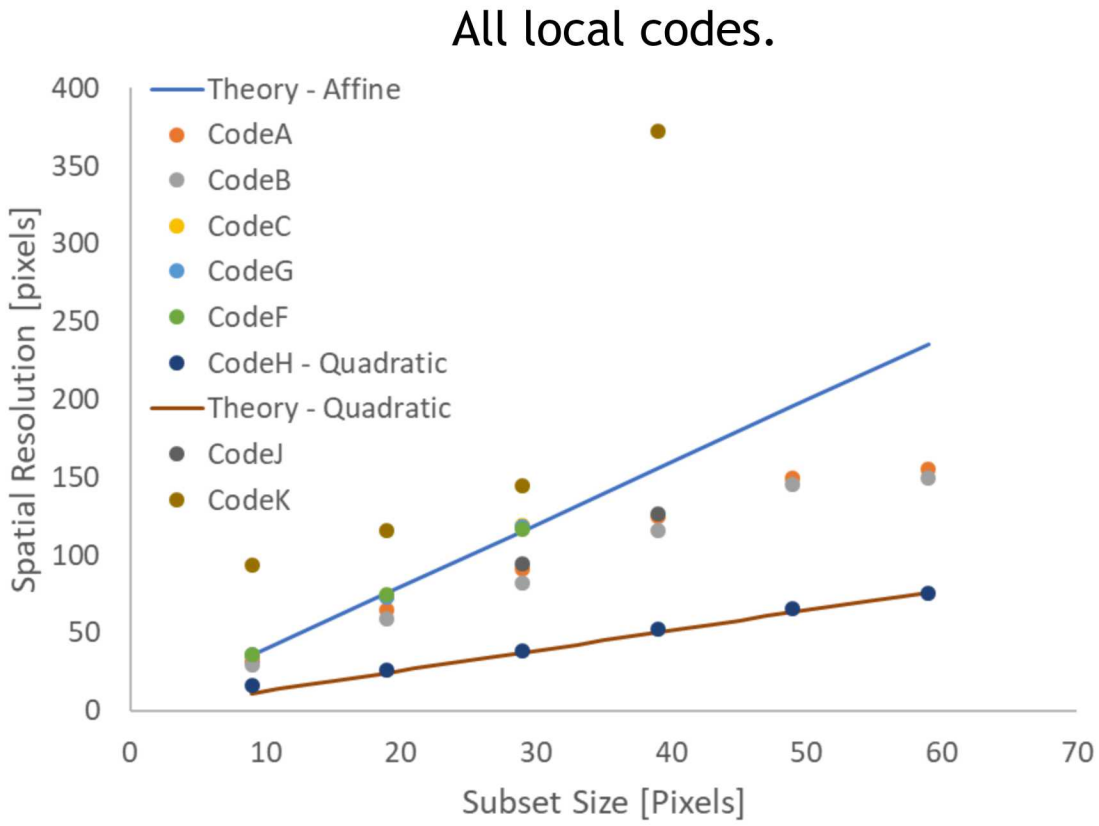


Full-field displacement results showing the trade-off between spatial resolution and noise.



- Selected subset sizes (or element size) from smallest to relatively large.
- All are on the same scale

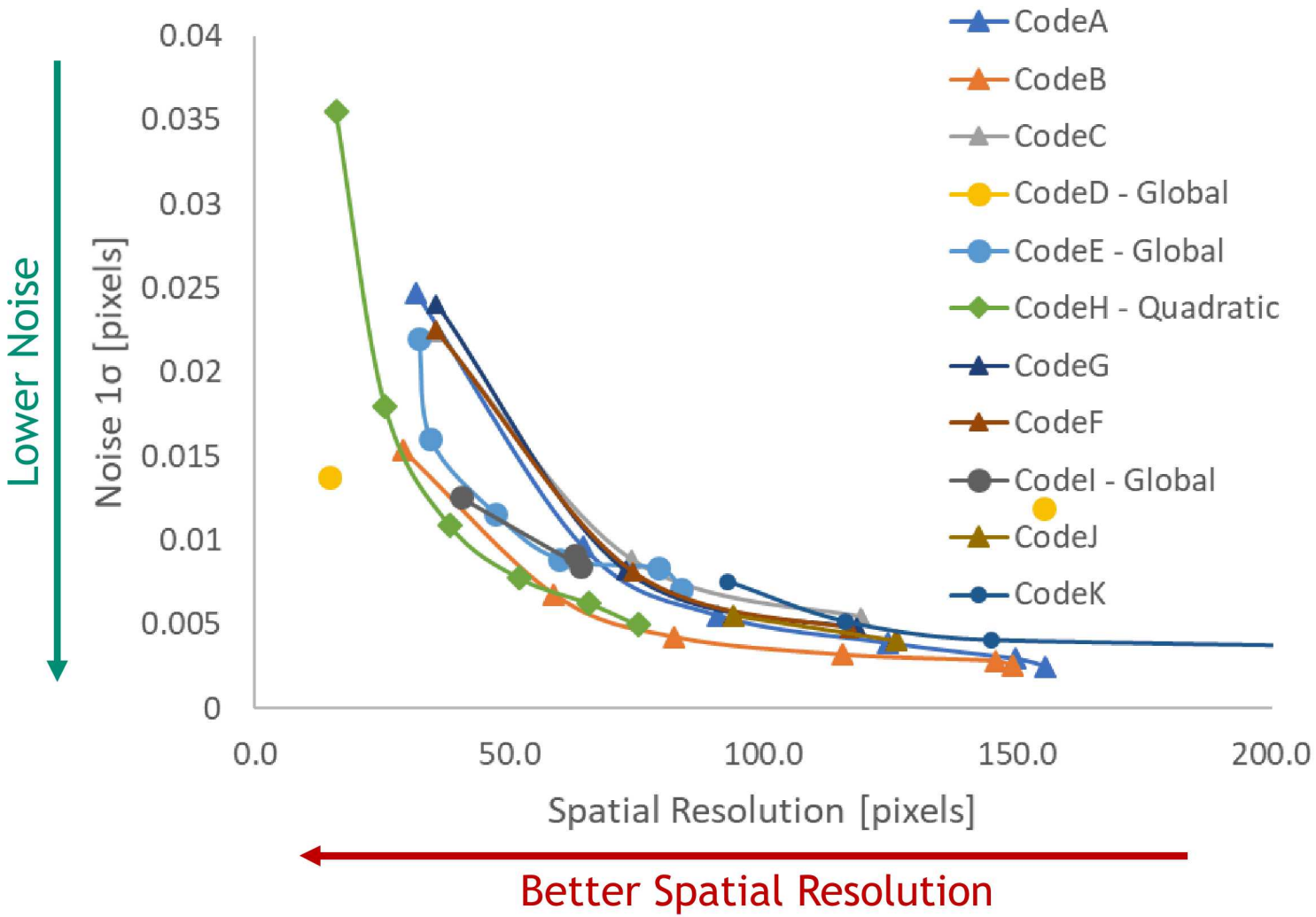
Displacement results match the theoretical spatial resolution predictions.



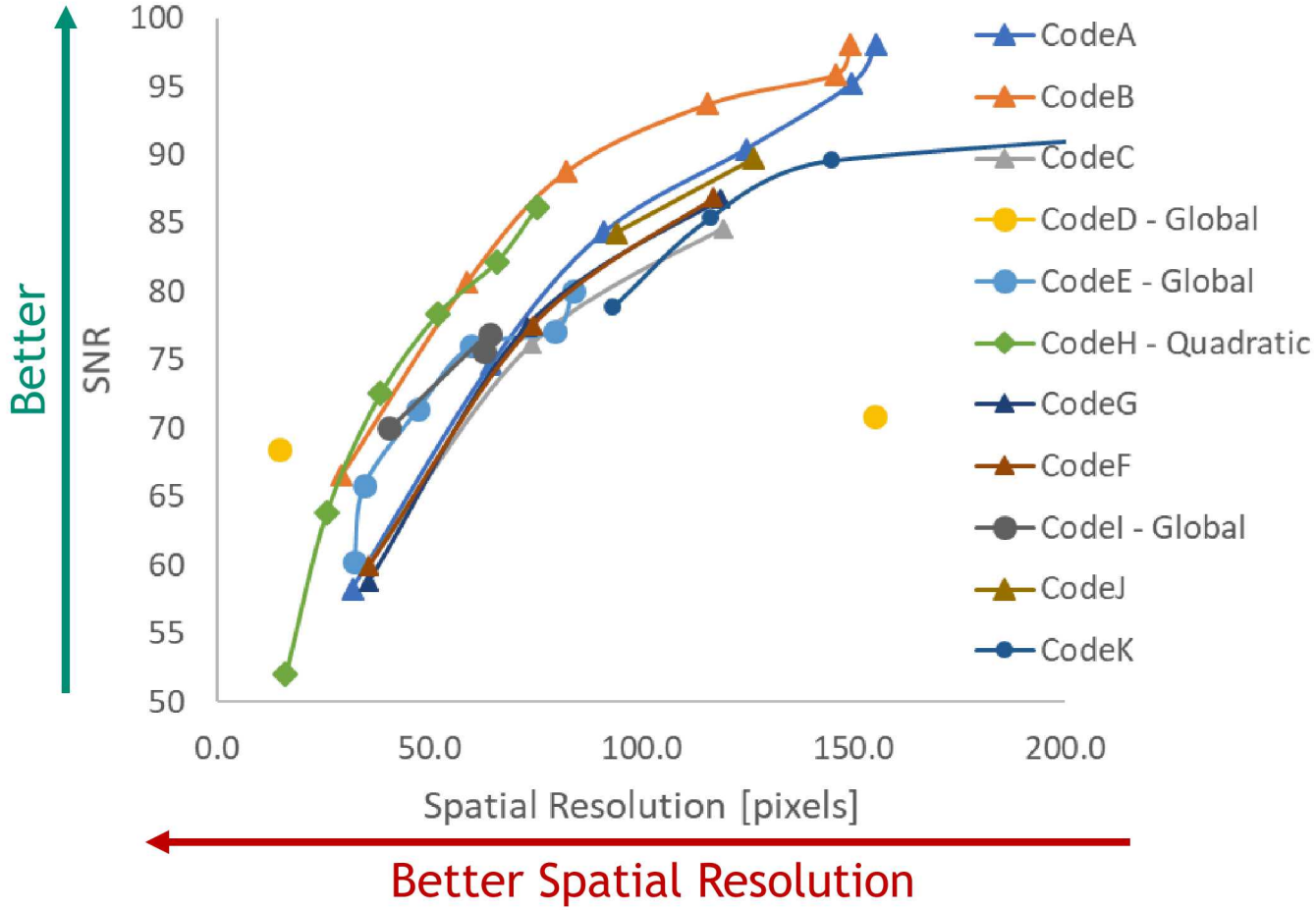
- For a rectangular weighting on the subset.
- Gaussian windowing performs slightly better.
- Some different approaches yield results that are quite different.

- Grediac, M., et al. (2017). "A Critical Comparison of Some Metrological Parameters Characterizing Local Digital Image Correlation and Grid Method." Experimental Mechanics **57(6): 871-903.**

There is a trade-off between spatial resolution and noise for **all** DIC codes – both global and local.

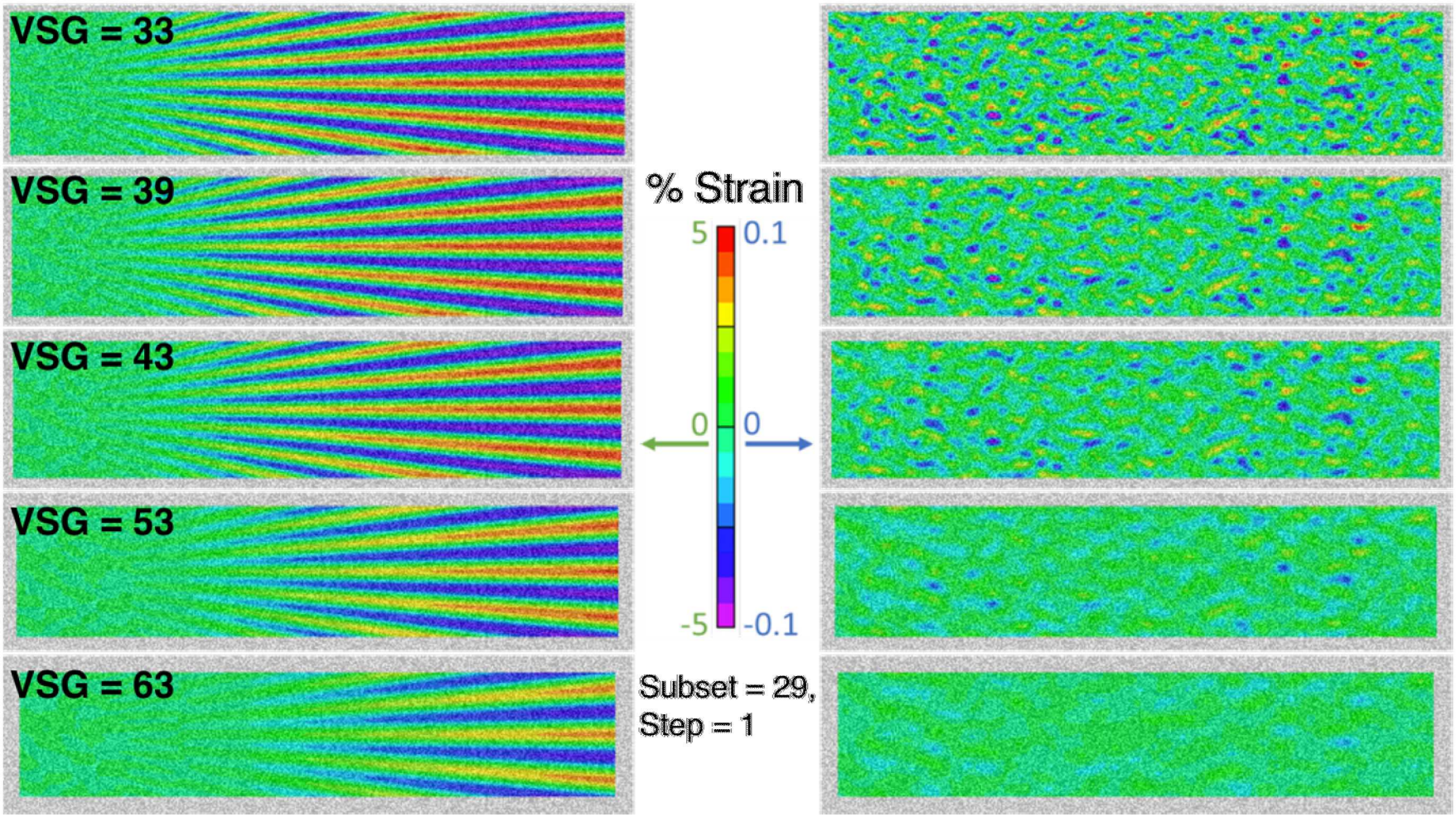


Signal to noise and spatial resolution are similar for all implementations.



$$SNR = 20Log_{10}(A_{signal}/A_{noise}) \text{ where } A_{signal} = 0.5 \ \& \ A_{noise} = \sigma^2$$

Typical full-field strain results for a single code. Virtual Strain Gauge (VSG) from "small" to "large".



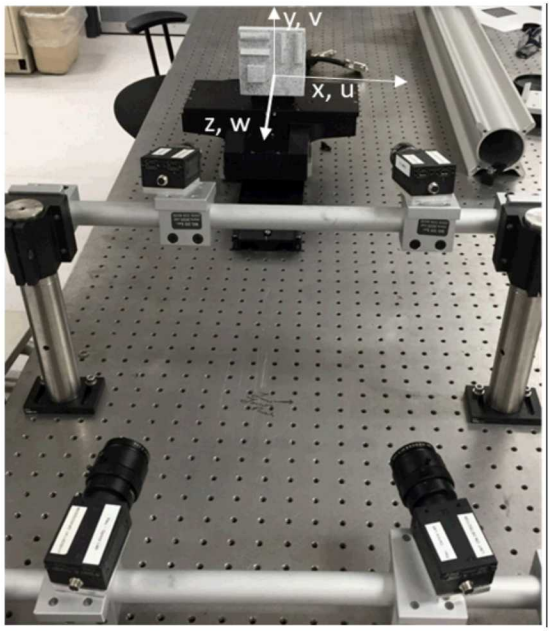
VSG = [(Strain Window - 1)*Step]+Subset

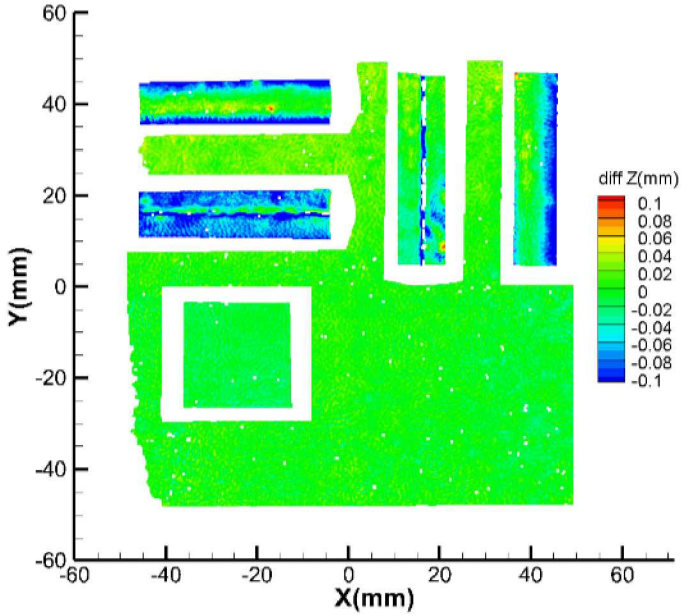
Add final call to be included in the paper. Can your code do better?

Participating Codes

1. Correlated Solutions
2. GOM
3. DICe Global
4. DICe Local
5. MatchID/AdaptID
6. LaVision
7. Dantec
8. CorreliSTC
9. ALDIC
10. Ncorr

Stereo-DIC Results are also due to Jeff Helm.





iDICs – A society to provide training, certification, standardization and guidelines for DIC.

Annual International DIC Society Conference

October 14 – 17, 2019 in Portland, OR

- Abstracts due: June 30th, 1 Pager and 250 words
- Certification Level 1 – Exams offered
- Classes: DIC 101, 201, Patterning and Grid

Accomplishments

- DIC Good Practices Guide (Freely Available)
- Certification Level 1 – First tests done
- 4 International Conferences

Committees

- Standards & Best Practices – Mark Iadicola
- Training & Certification – Tim Schmidt
- Applications – Dave Dawicke
- University Education – Mark Pankow
- DIC Challenge – Phillip Reu

Mission: Extend – Improve – Train

Extending the Frontiers: Training the next Generation: Standardizing for Industry: Improving our