

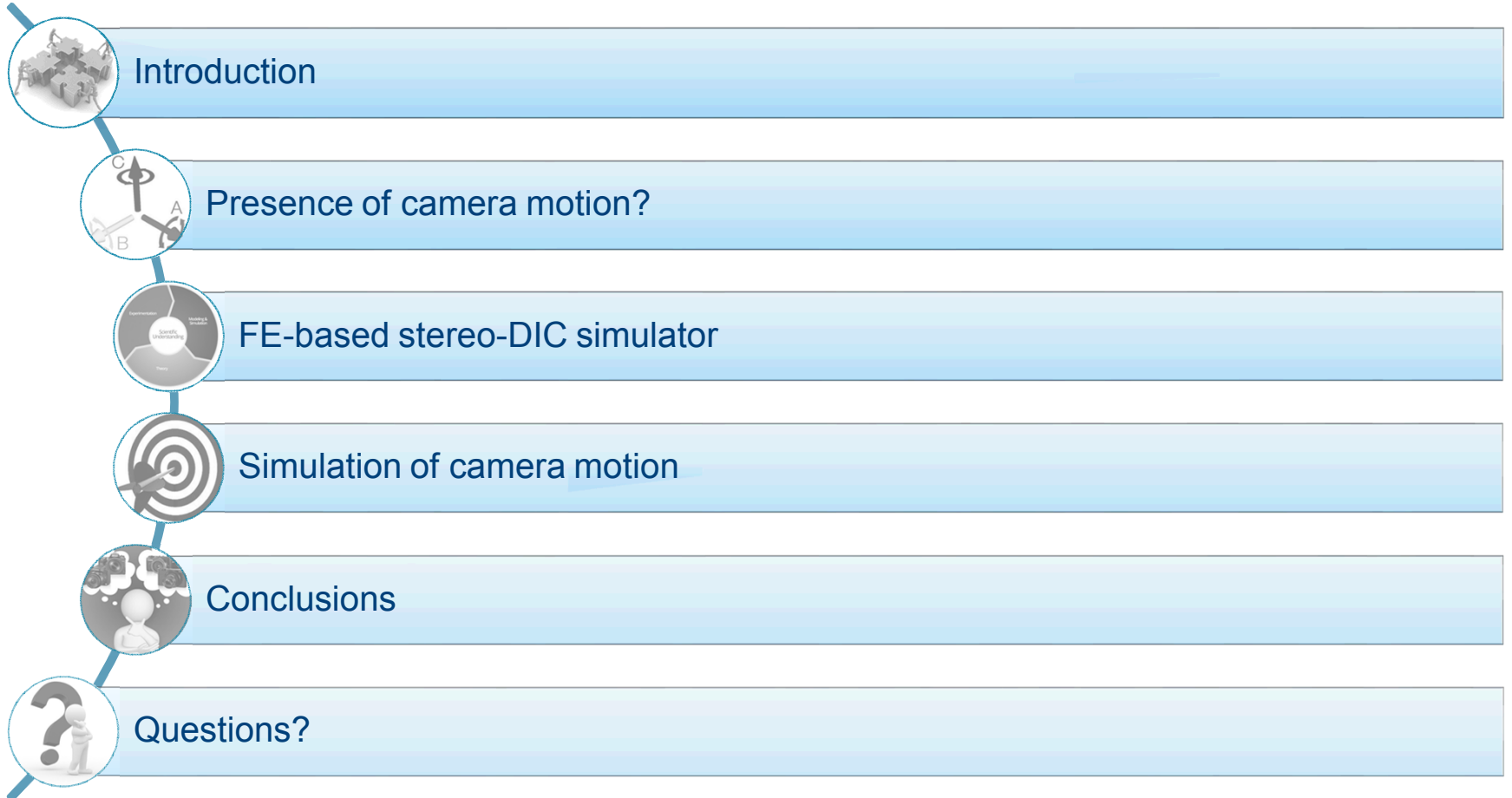


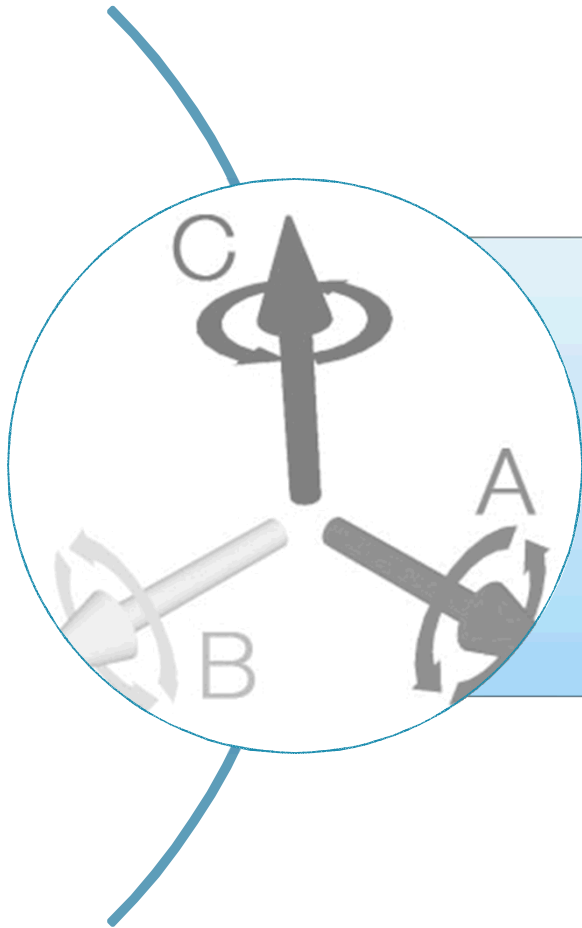
Evaluation of camera motion in stereo-DIC

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Ph.D. student

Content presentation





Presence of camera motion?

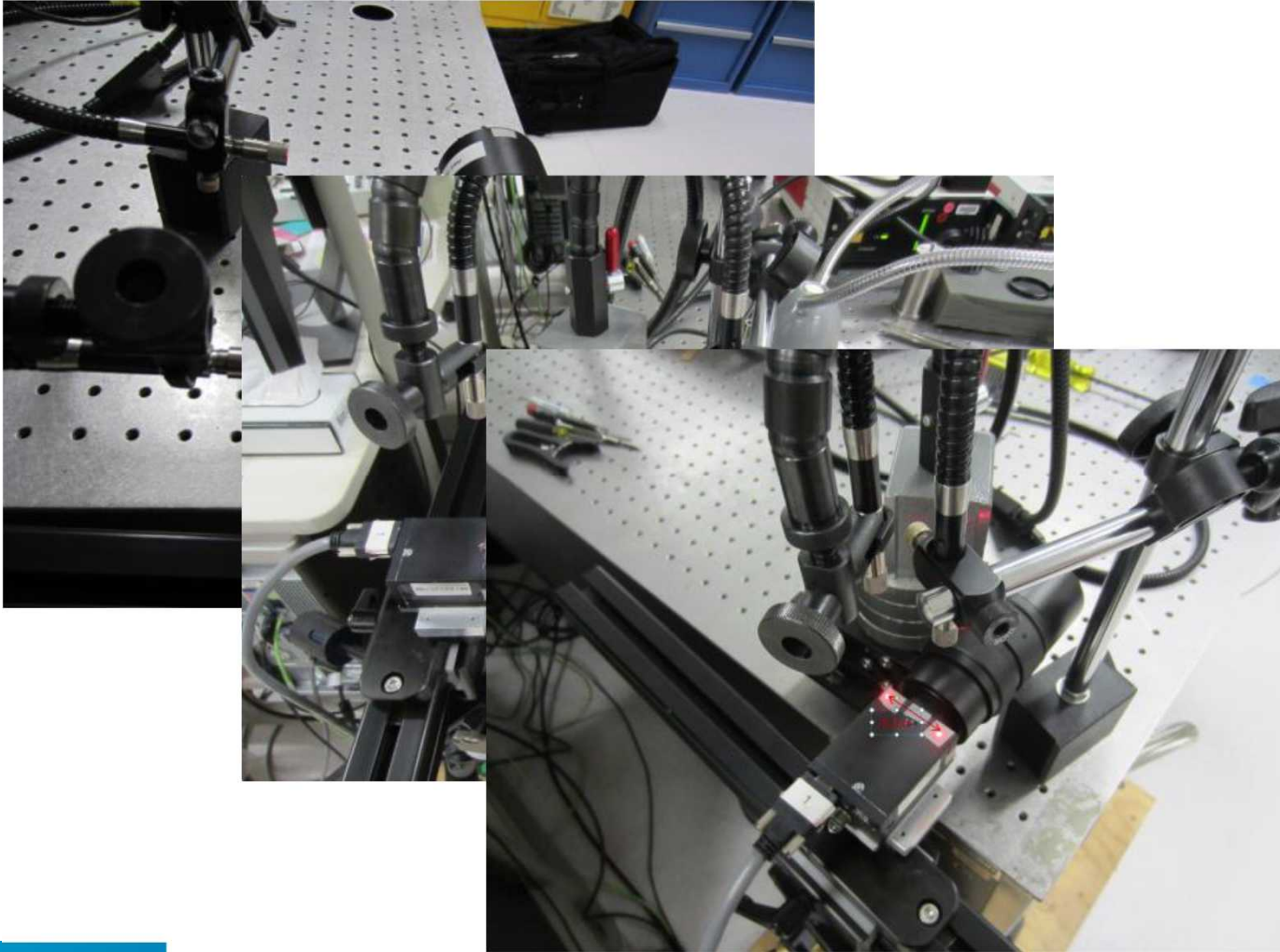


Presence of camera motion?

- Single camera DIC set up
- Compressor standing in vicinity of set up
- 75mm lens
- Looking at a flat plate (100mm FOV)
- 2 LDV's for measuring camera motion/rotation

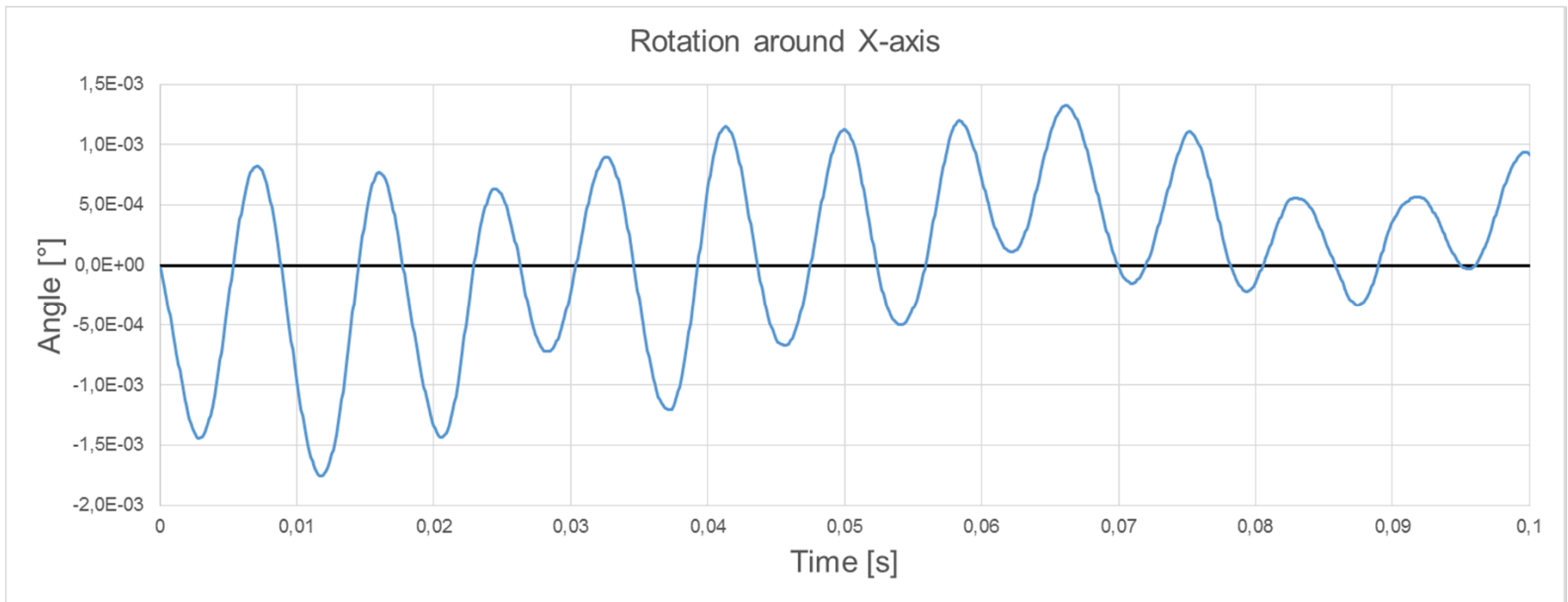
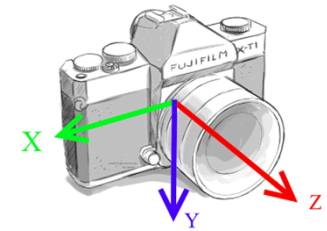


Presence of camera motion?



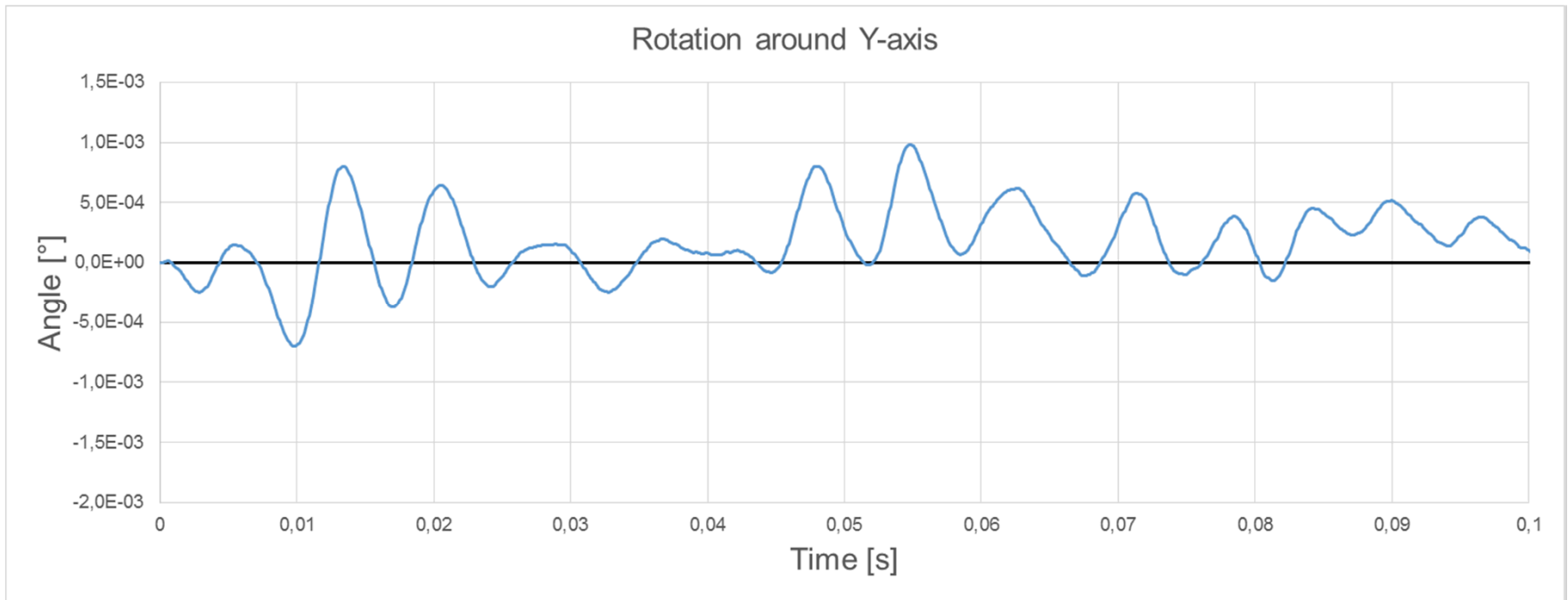
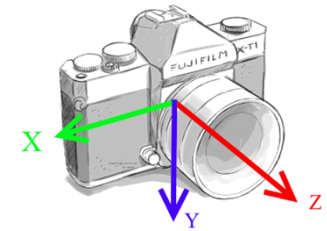


Presence of camera motion?



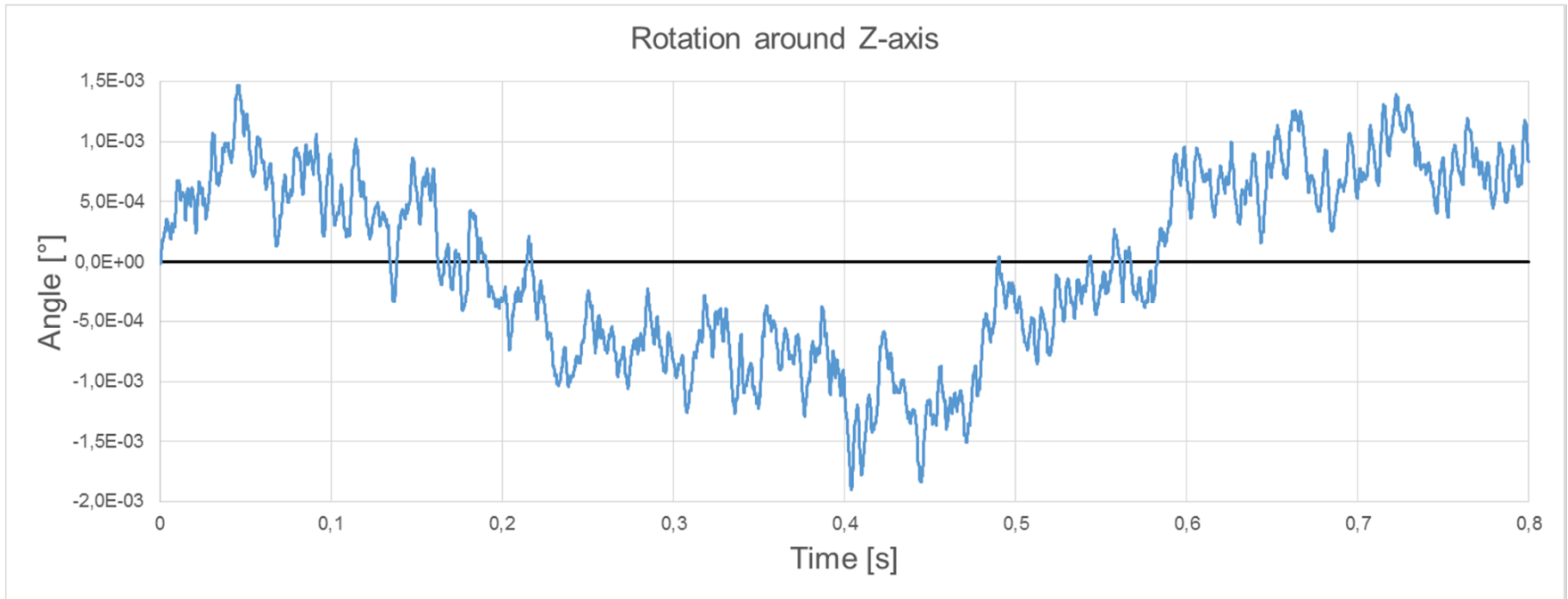
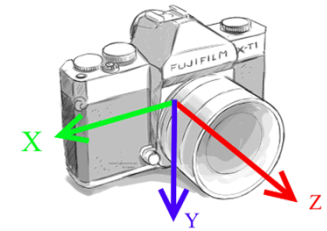


Presence of camera motion?





Presence of camera motion?





Presence of camera motion?

- Video U motion 2D DIC



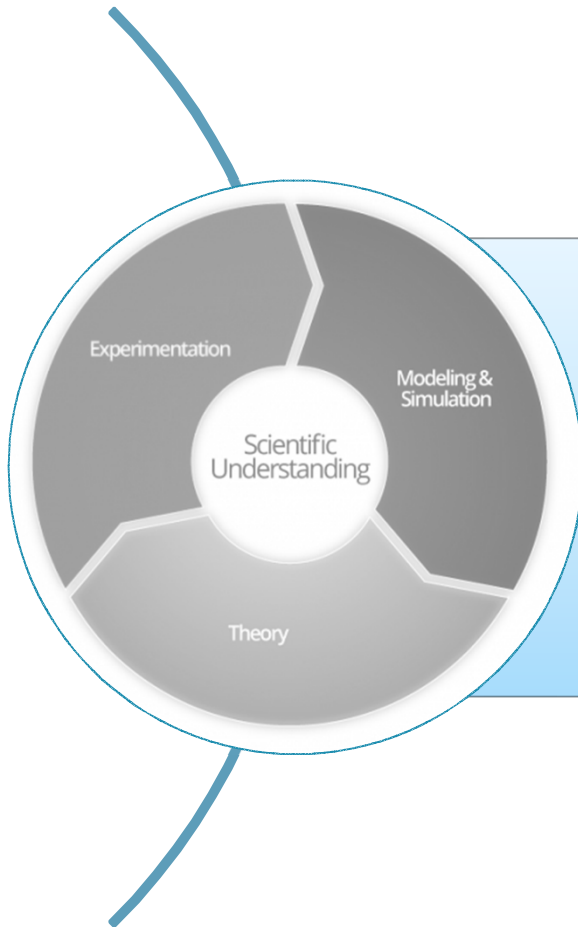
Presence of camera motion?

- Video V motion 2D DIC



Presence of camera motion?

**YEAH
IT'S THAT
BAD**



FE-based stereo-DIC simulator



- **Goal:**
 - **Generating images as true as possible by**
 - Using an FE mesh for deforming images
 - Using a real speckle pattern
 - Using set-up properties
 - **Including**
 - ✓ System resolution
 - ✓ Noise
 - ✓ Camera motion
 - ✓ Contrast/lighting
 - ✓ Calibration
 - ✓ Lens distortions
 - ✓ Image blur/depth of field
 - ✓ Sample motion
 - ✓ Aliasing
 - ✓ ...



- **Goal:**
 - **Generating images as true as possible by**
 - Using an FE mesh for deforming images
 - Using a real speckle pattern
 - Using set-up properties
 - **In order to**
 - Perform (stereo-) DIC uncertainty quantification
 - ✓ Calibration
 - ✓ Correlation
 - ✓ Noise
 - ✓ Camera motion/vibrations
 - ✓ Influence of calibration data
 - ✓ Aliasing
 - ✓ Set-up
 - ✓ ...
 - Optimal set-up/specimen geometry selection
 - Validation of new DIC-codes



FE-based stereo-DIC simulator

- Presented in
 - “Finite element based image generator for uncertainty quantification on stereo-digital image correlation: a best practice guide for calibration” submitted in Experimental Mechanics
 - “Stereo-DIC uncertainty quantification based on simulated images” submitted in Experimental Mechanics



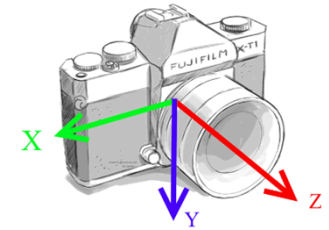
Simulation of camera motion



Simulation of camera motion: setup 1 - no deformation



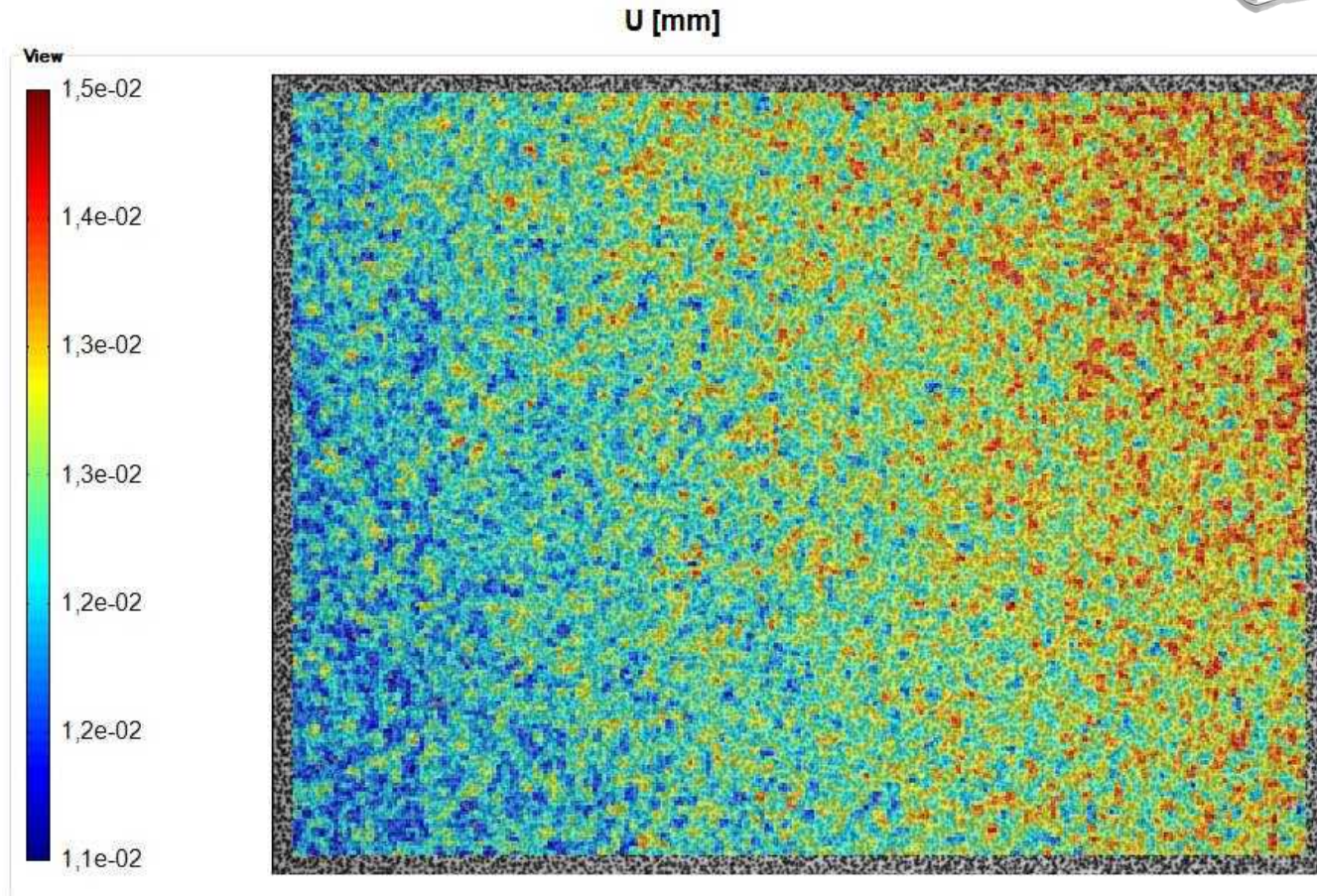
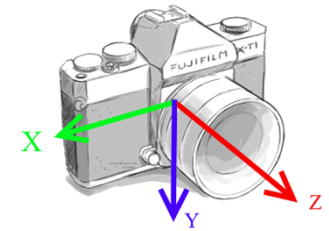
Simulation of camera motion: setup 1



- 100mm FOV
- Stereo-DIC set-up simulations:
 - Horizontal set-up
 - 1 perpendicular camera to check 2D correspondence
 - All possible combinations of camera-rotations of
 - $\pm 1.1 \text{ E}^{-3} \text{ }^\circ$ around x-axis
 - $\pm 5.0 \text{ E}^{-4} \text{ }^\circ$ around y-axis
 - $\pm 3.0 \text{ E}^{-4} \text{ }^\circ$ around z-axis
 - Changing stereo angles of 10° & 20°
 - Changing focal length lenses of 16mm, 35mm, 75mm

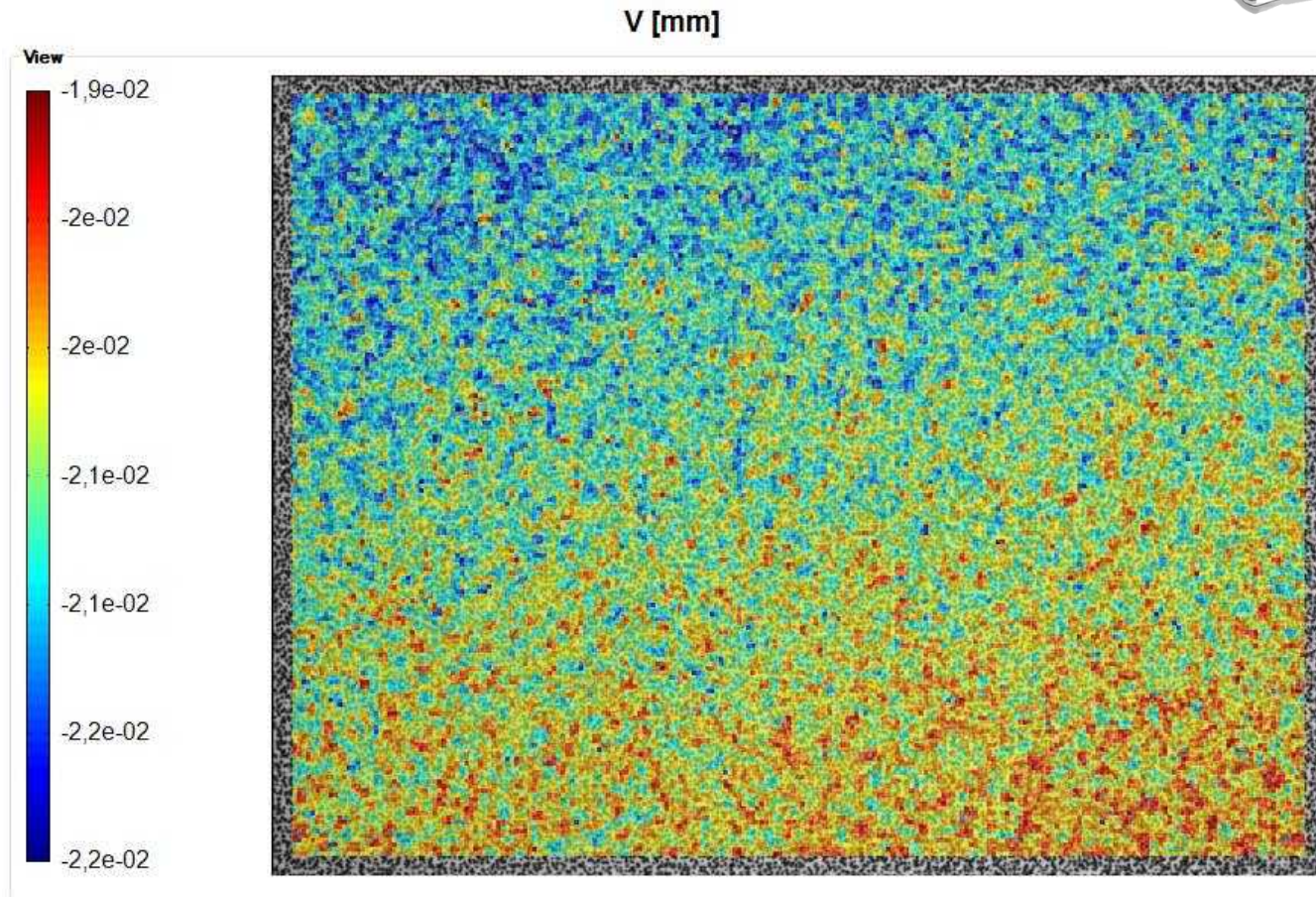
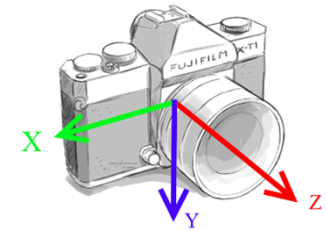


Simulation of camera motion: results setup 1



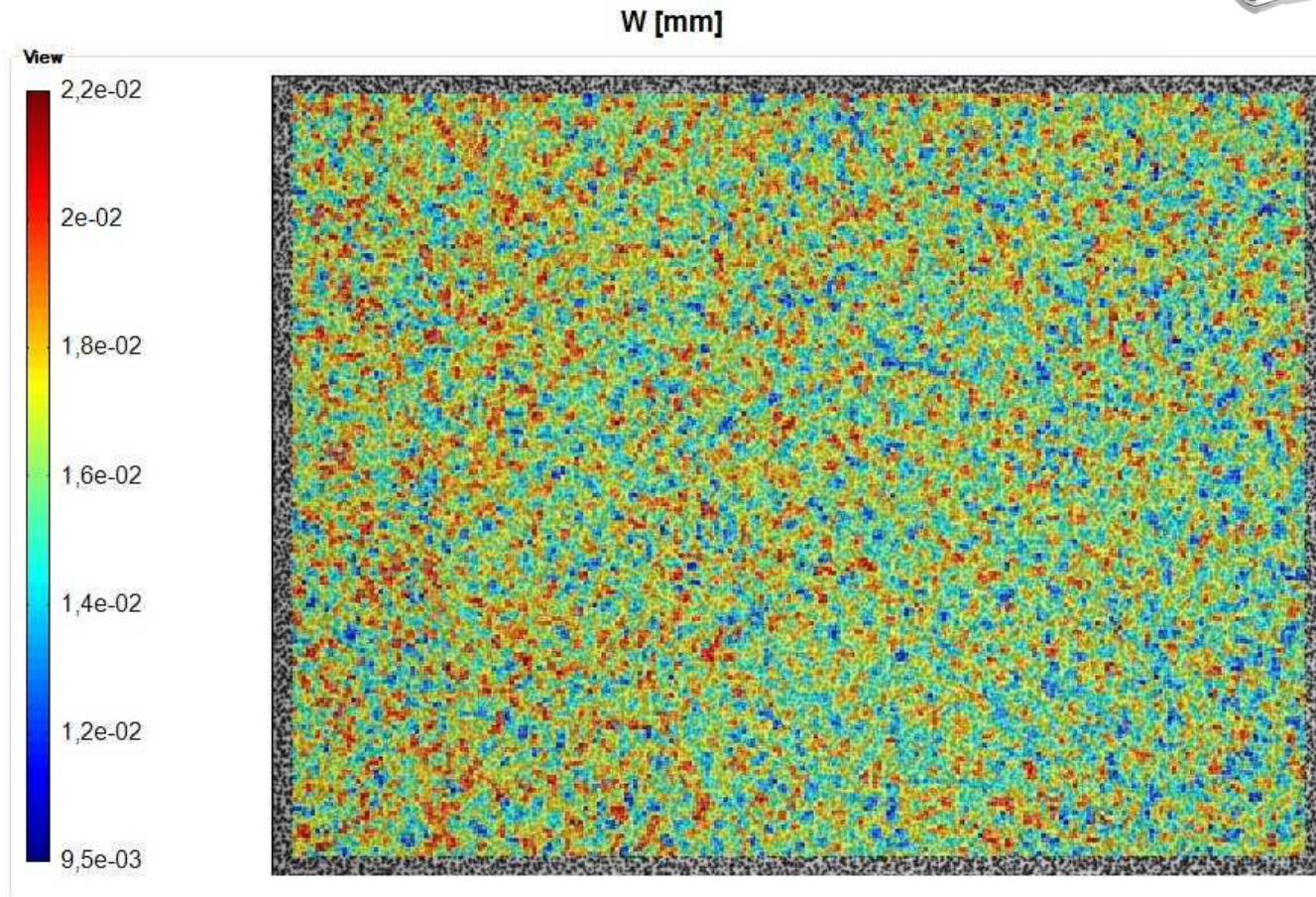
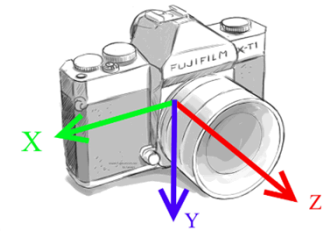


Simulation of camera motion: results setup 1





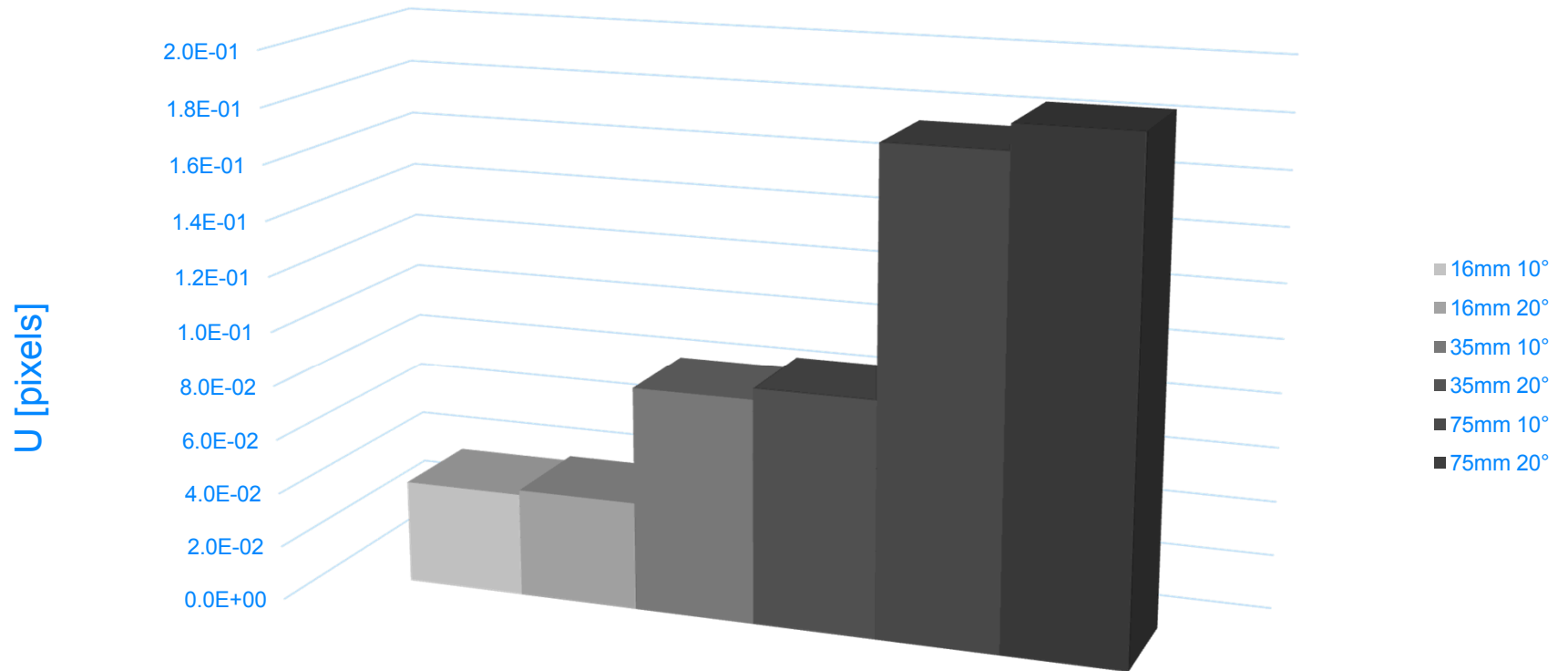
Simulation of camera motion: results setup 1





Simulation of camera motion: results setup 1

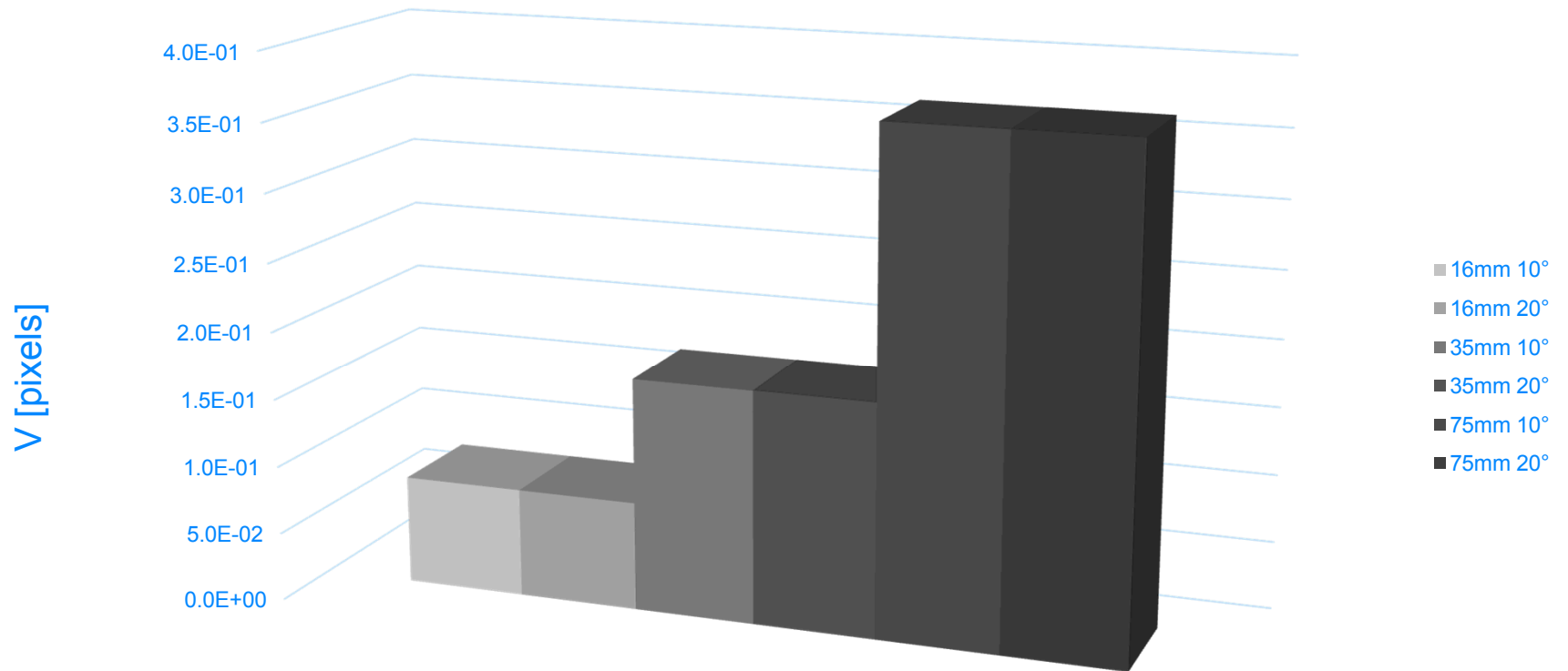
Average U [pixels]





Simulation of camera motion: results setup 1

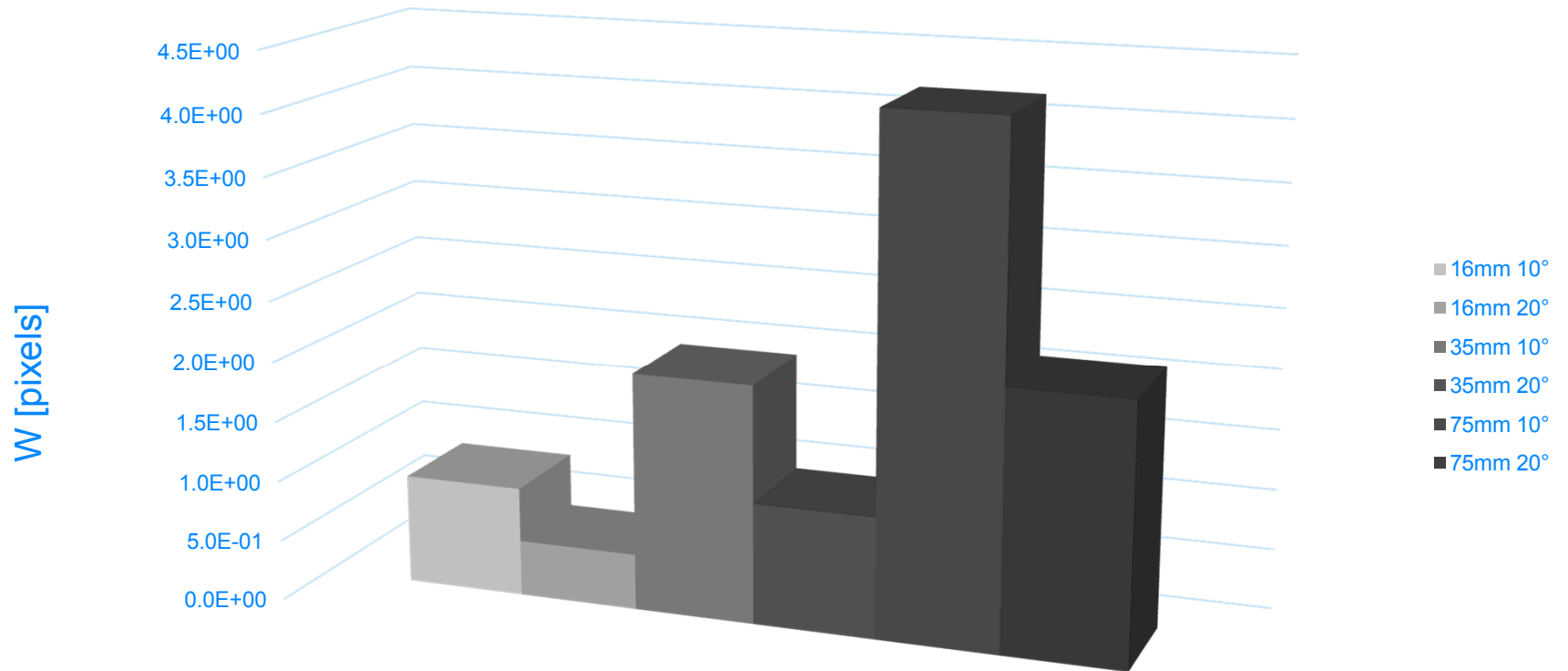
Abs average V [pixels]





Simulation of camera motion: results setup 1

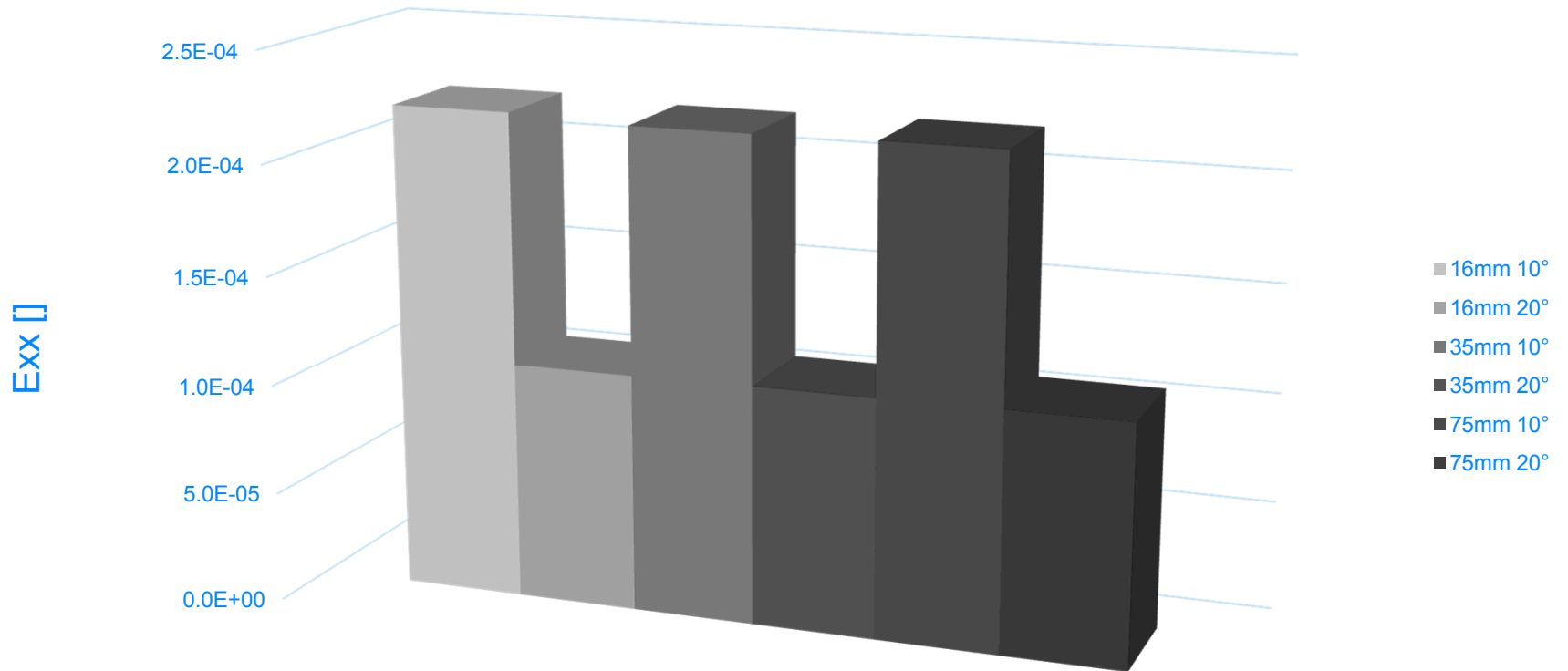
Abs average W [pixels]





Simulation of camera motion: results setup 1

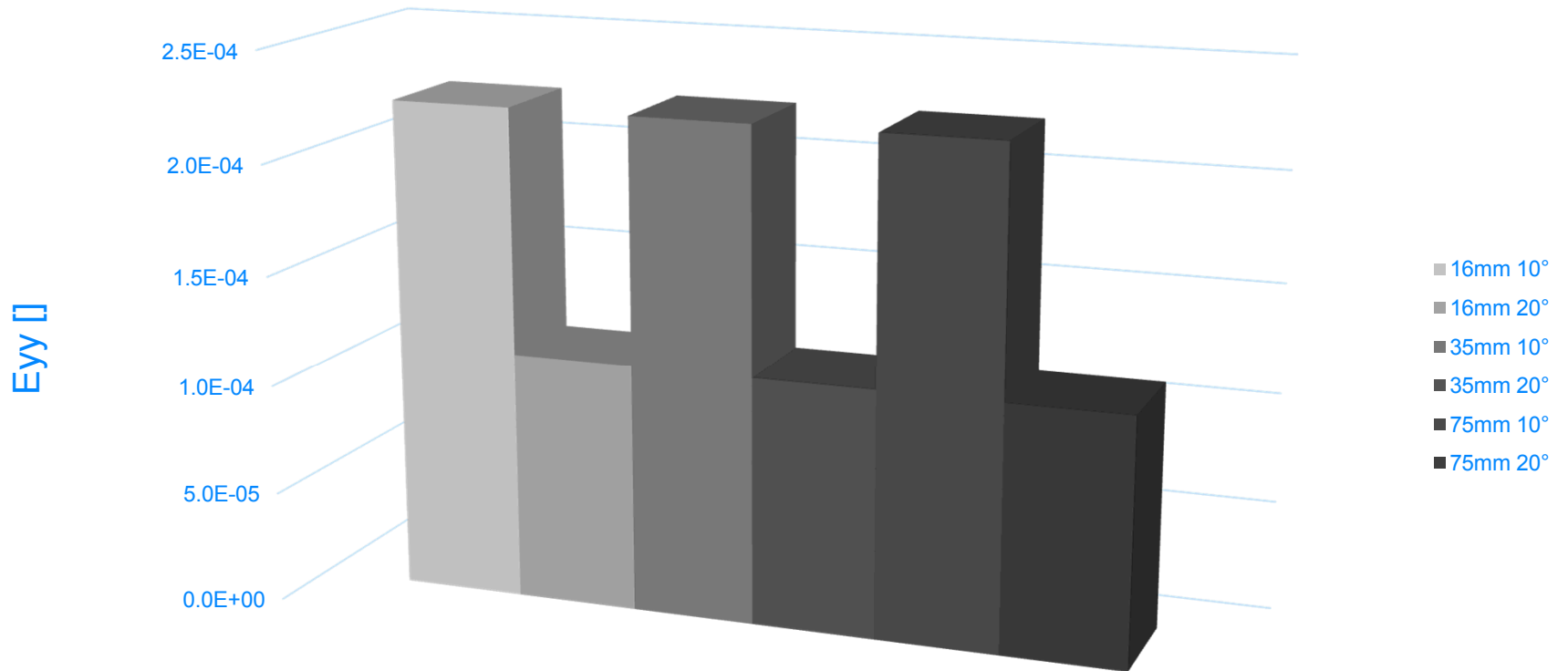
Average Exx []





Simulation of camera motion: results setup 1

Average Eyy []



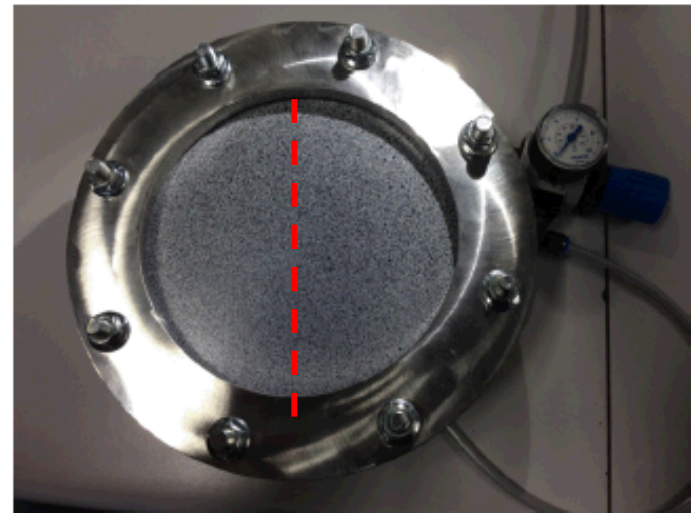


Simulation of camera motion: setup 2 – deformation



Simulation of camera motion: setup 2

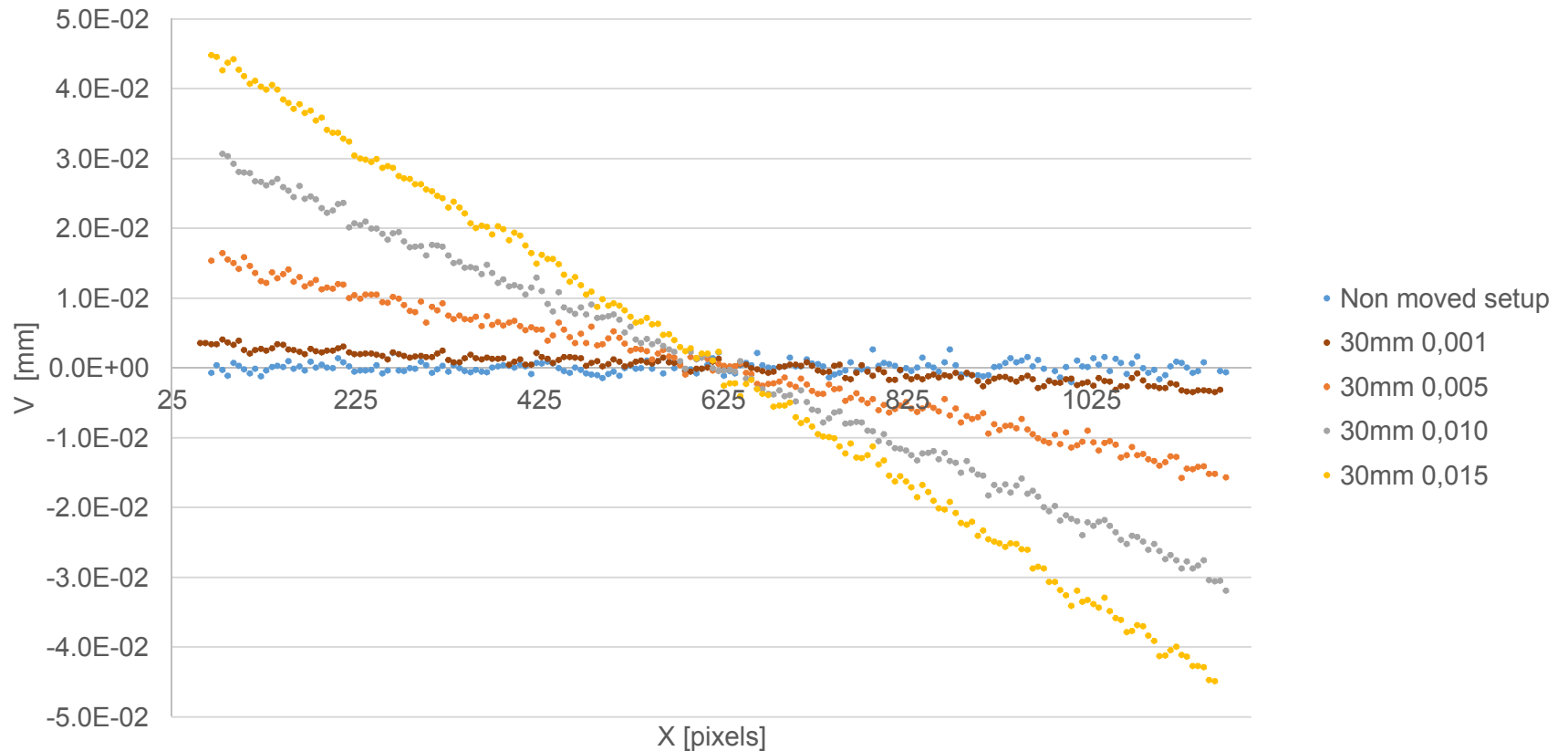
- Bulging experiment
 - 50mm radius
 - 3mm thick S235JR steel
 - 30 bar load
- DIC set up
 - 30mm lenses
 - 30° stereo angle
 - Lens distortions and noise are present
 - Perfect calibration data
 - Increasing camera rotation





Simulation of camera motion: results setup 2

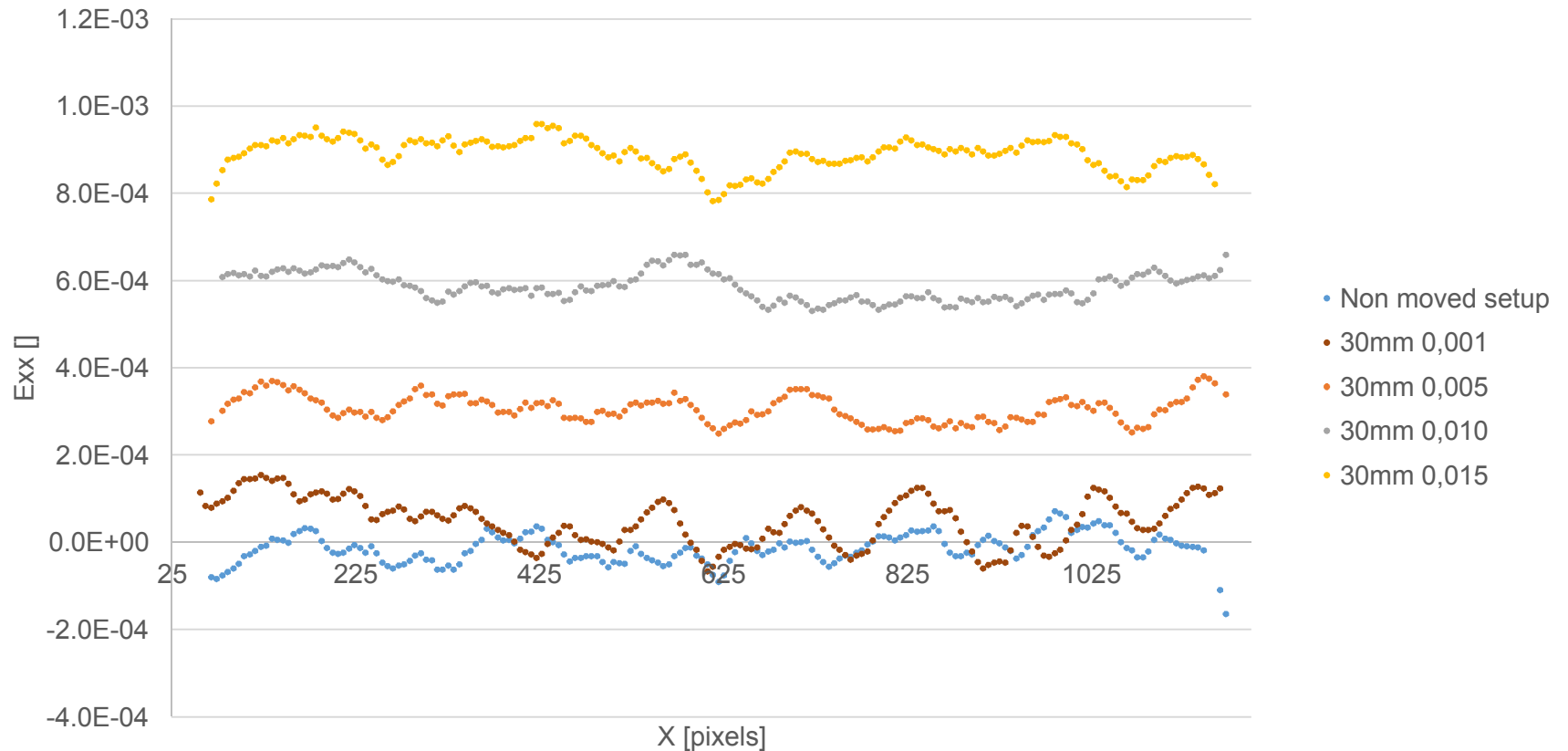
Influence of moving camera - V [mm]





Simulation of camera motion: results setup 2

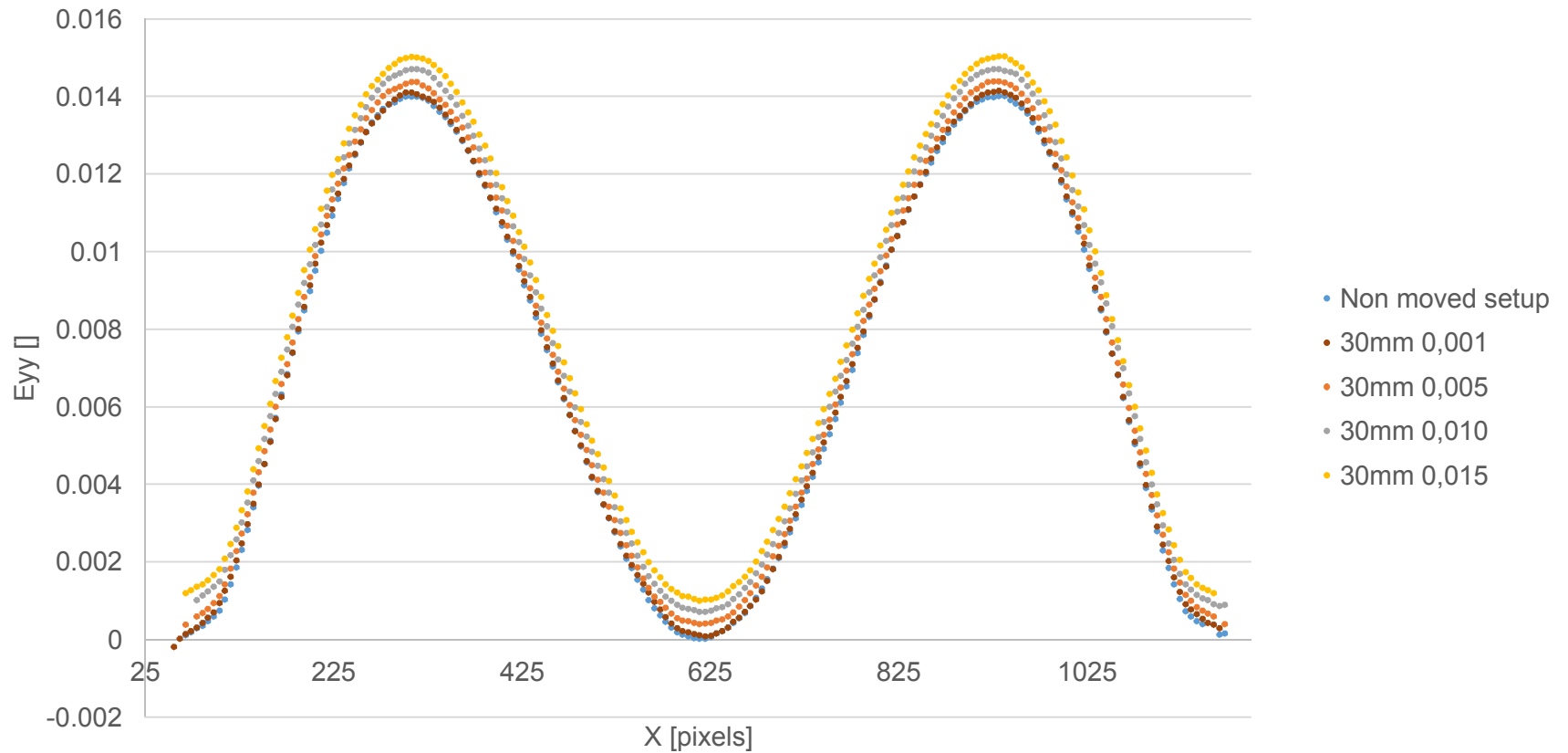
Influence of moving camera - Exx []





Simulation of camera motion: results setup 2

Influence of moving camera - Eyy []





Conclusions



Conclusions

- Camera motion is present and is influencing (stereo-) DIC measurements!
- Displacements are biased linearly
- Strains are offsetted
- Higher focal length lenses are more prone to camera motion
- Lower stereo-angles are worse
- Need for compensation?



Any questions?



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Thank you for your attention!

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