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# Assessment of microscopy moving stage performance down to the 10 nm range using encoded patterns with automated reading

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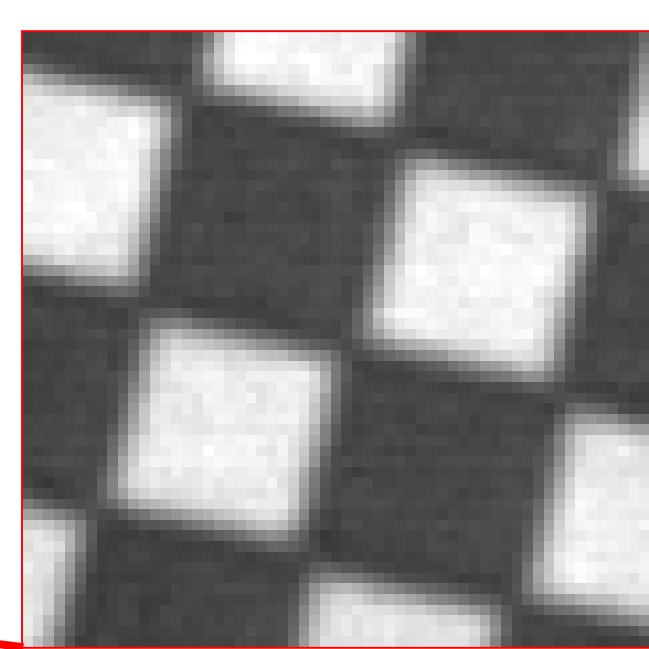
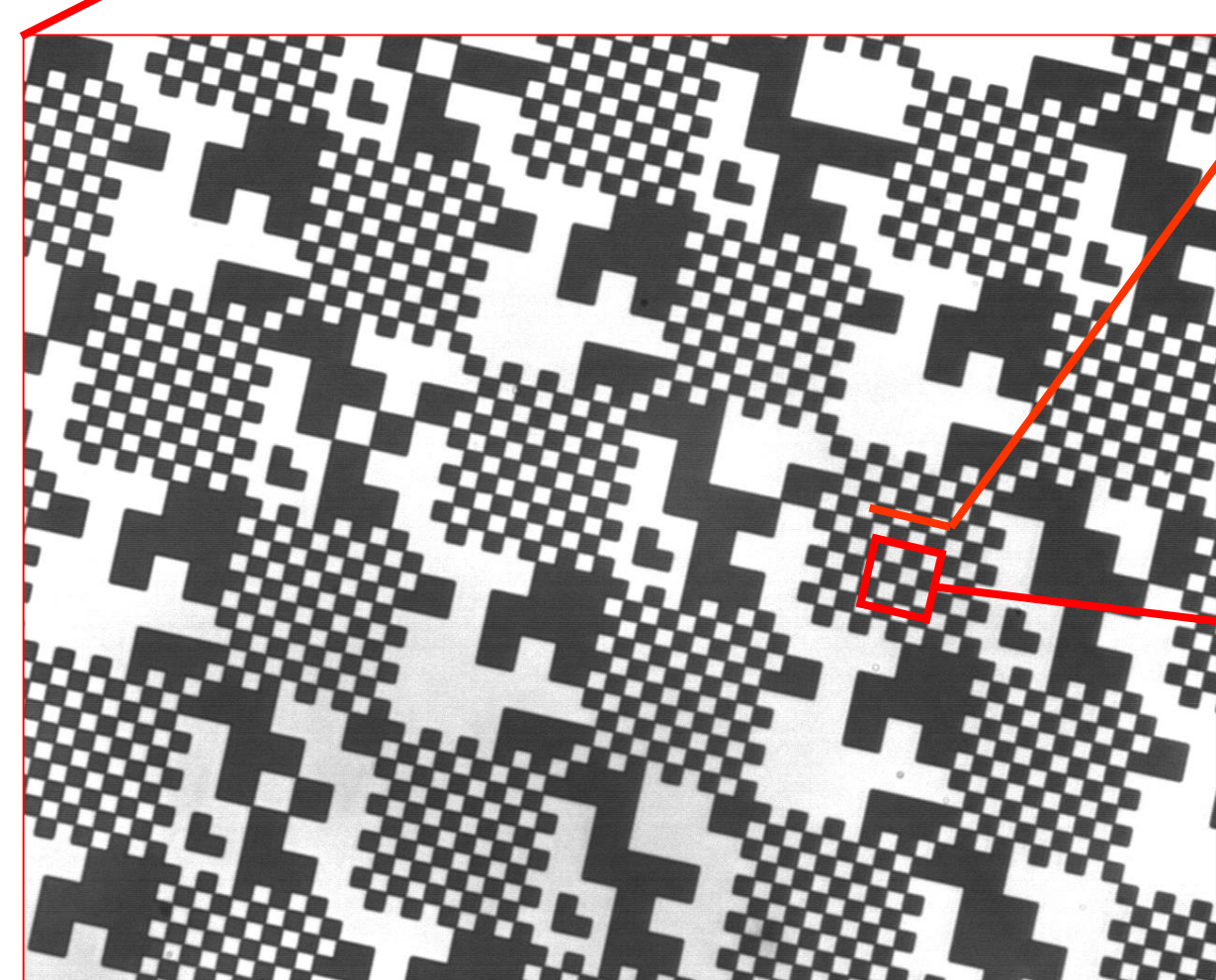
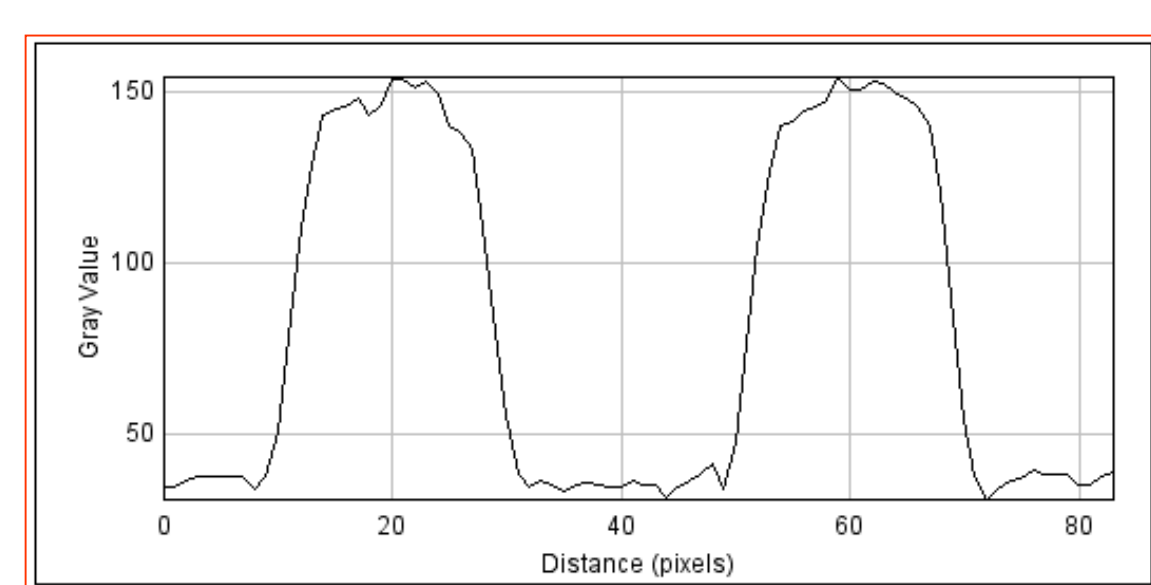
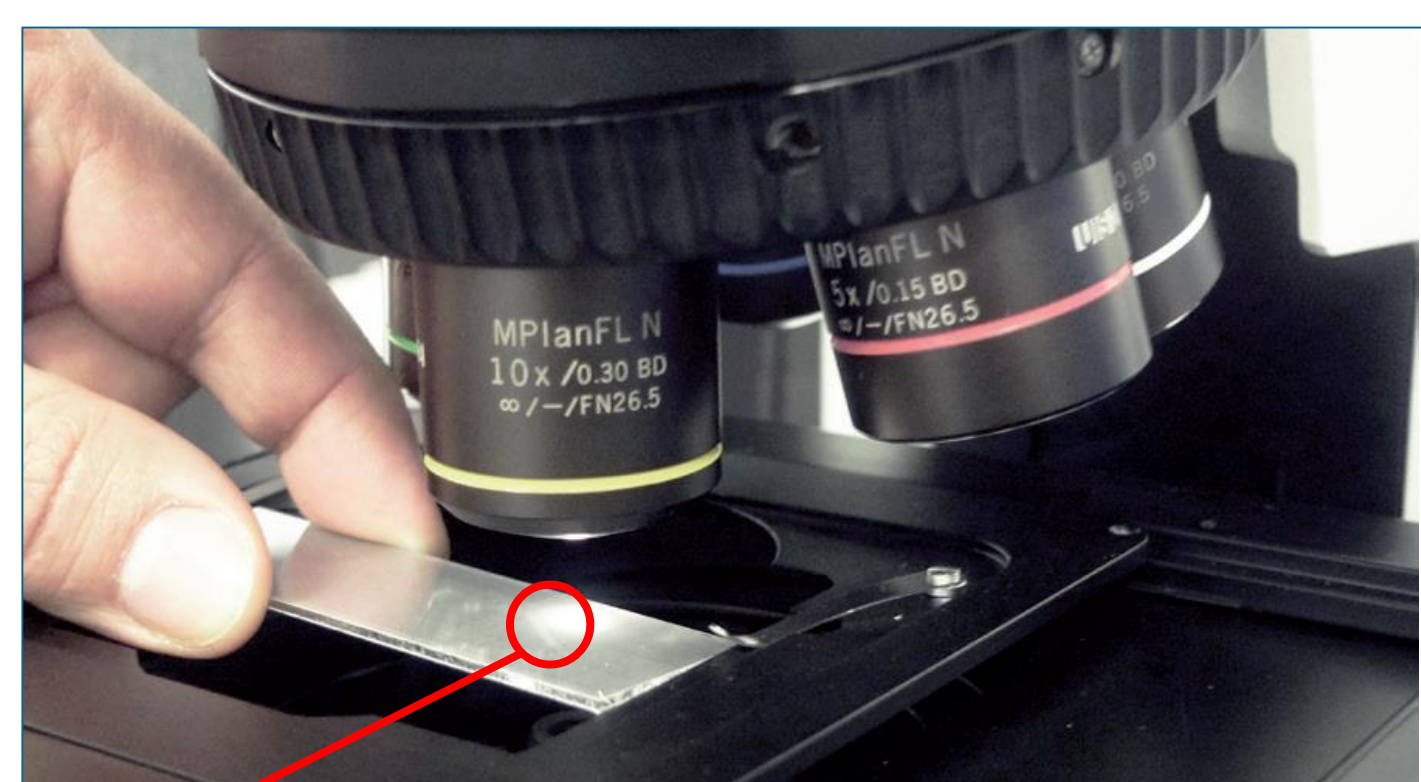
<sup>2</sup> HORIBA France SAS, Passage Jobin Yvon, 91120 Palaiseau, France. [olivier.acher@horiba.com](mailto:olivier.acher@horiba.com)

## Positioning accuracy in microscopy

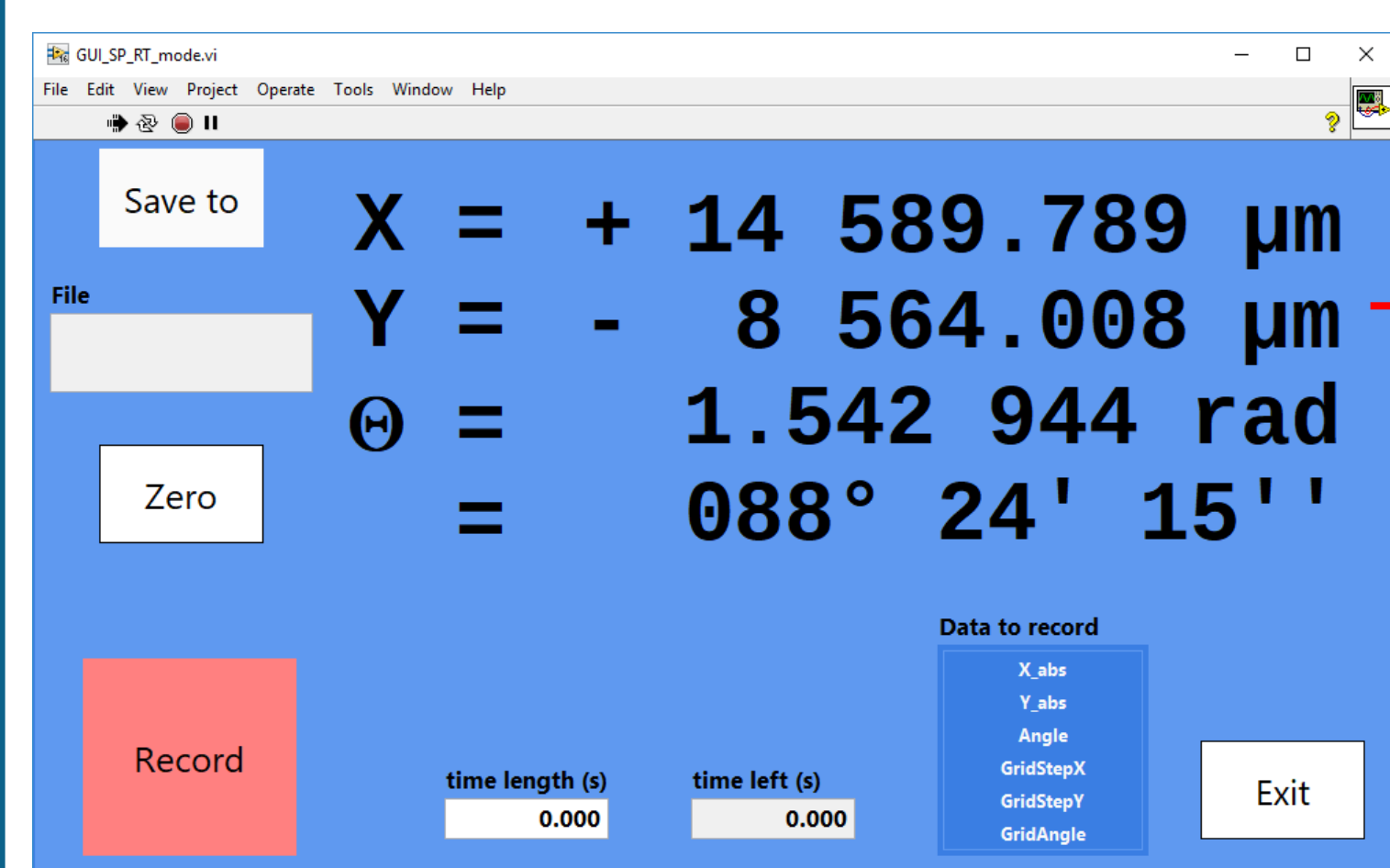
- What is the fidelity of the main stage to order?
  - Does it comply to orders? Does it come back to previous position?
- How stable is the instrument stand?

### Presentation of the nanoGPS technology

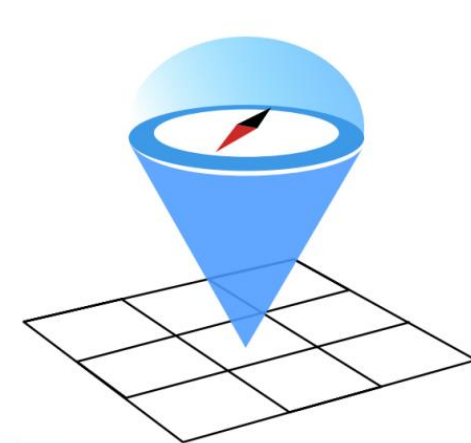
- The nanoGPS is composed of a encoded slide composed of QR code like patterns.
- Position reading by analysis pictures<sup>1,2</sup>.
  - QR code like patterns provide an estimate position.
  - Other patterns provide fine position and angle => X, Y,  $\theta$ .



- The software is used to track the position and record trajectories



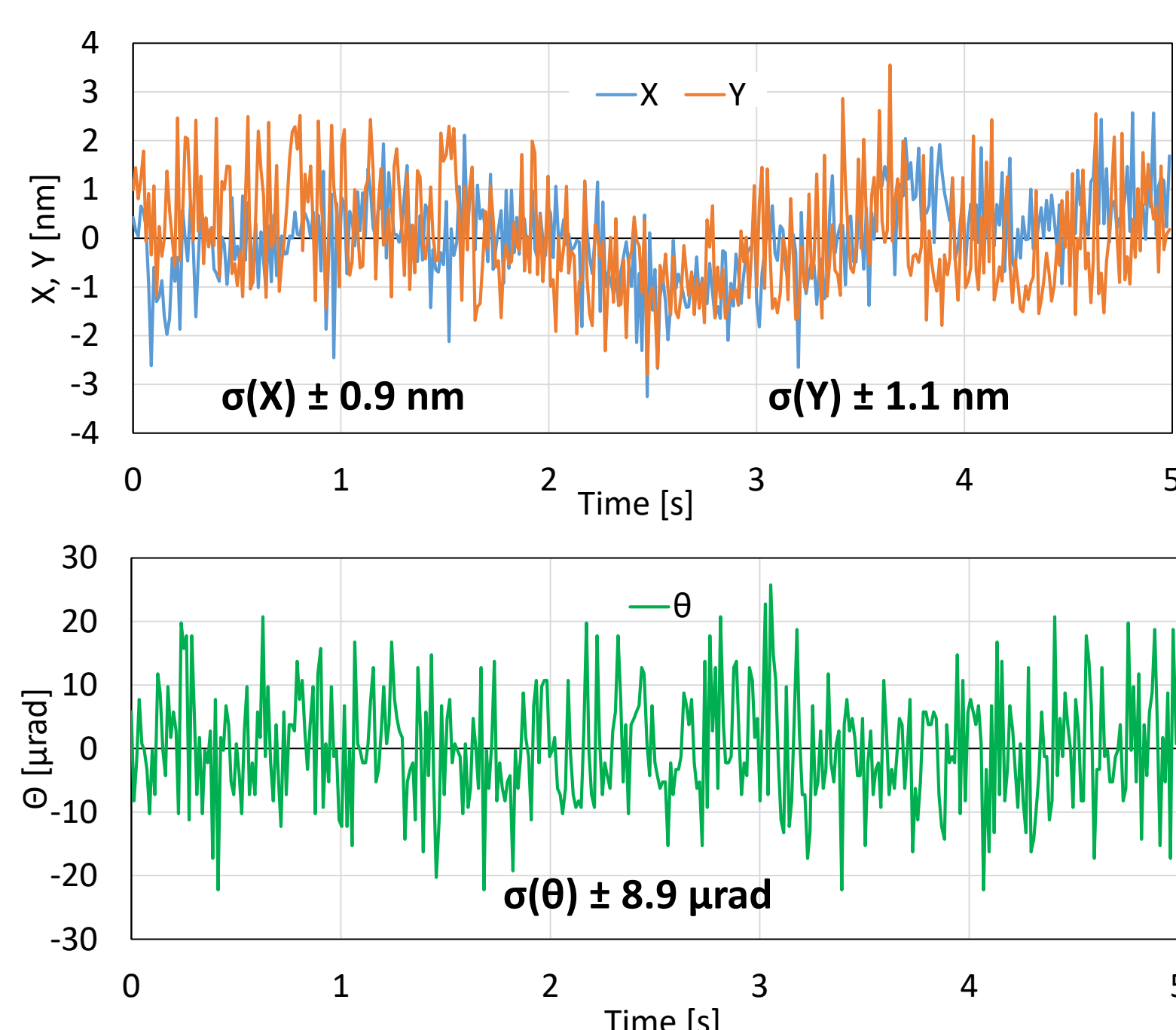
The software displays the coordinates and the angle live



nanoGPS Oxy $\theta$ <sup>®</sup>

### Discussion

- The nanoGPS works in superresolution mode<sup>3</sup>.
- Accuracy down to the 10 nm and 10  $\mu\text{rad}$  range.

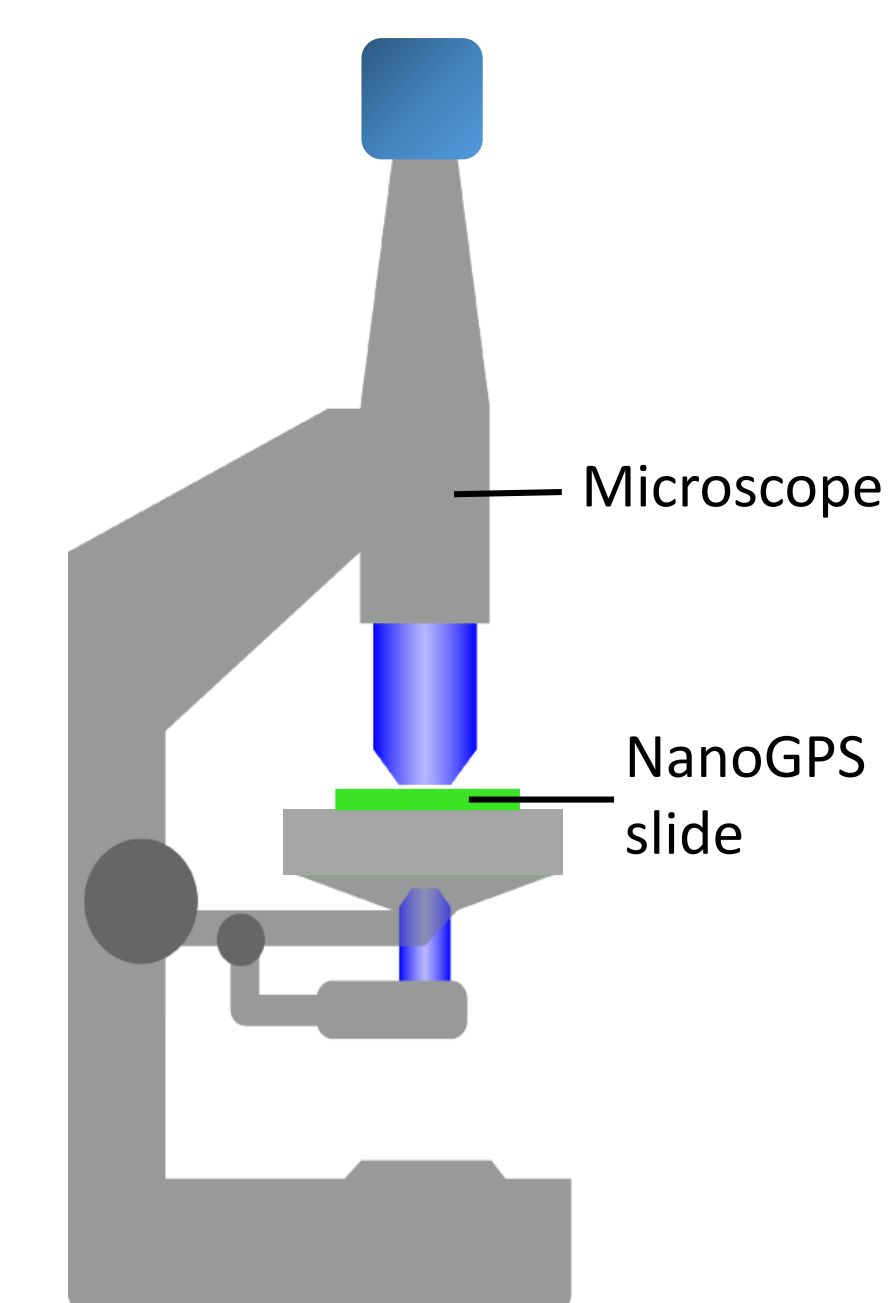
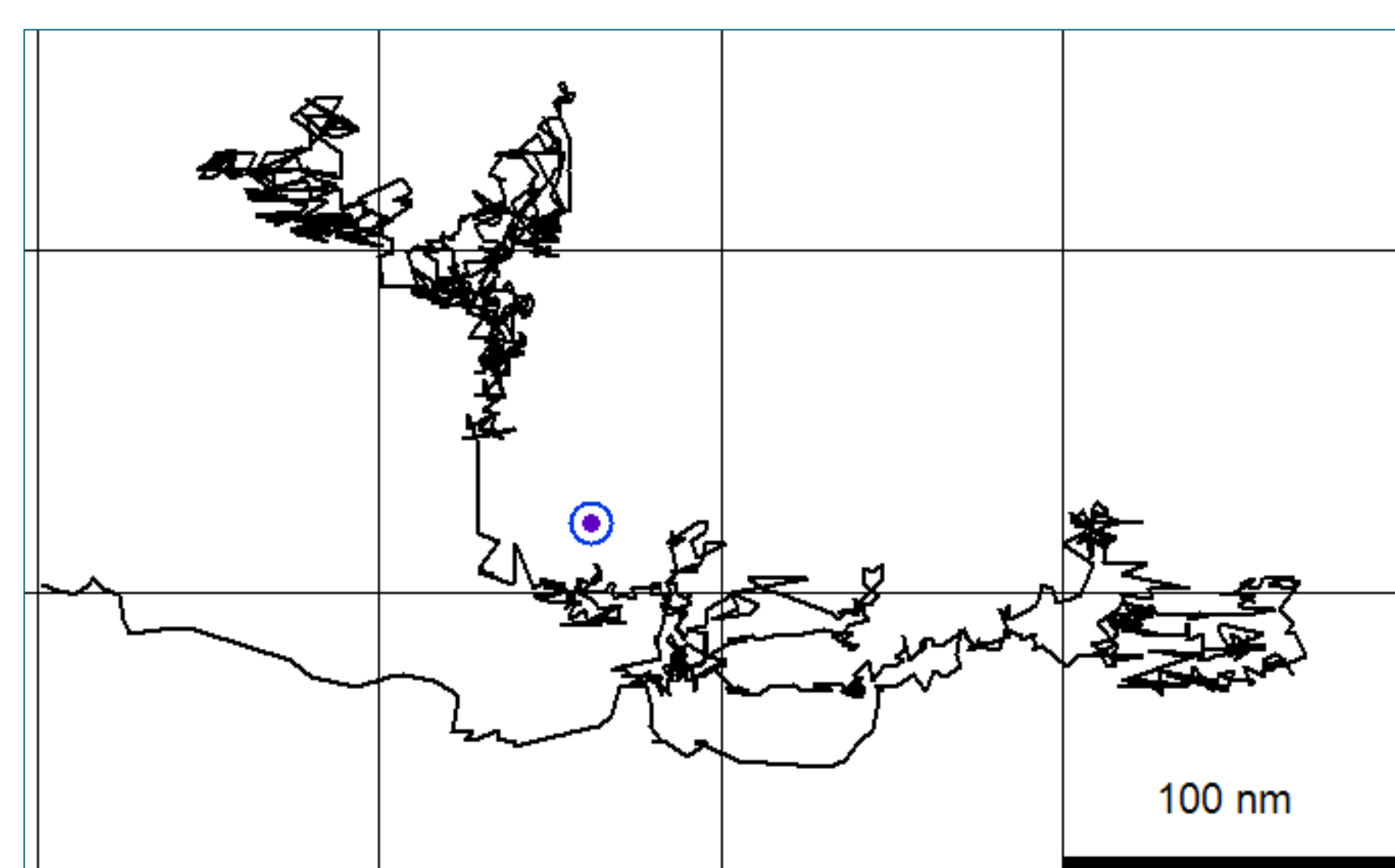


1. HORIBA patents  
2. P. Sandoz, R. Zeggari, L. Froehly, J. Prétet, C. Mougin, 2007, Position referencing in optical microscopy thanks to sample holders with out-of-focus encoded patterns J. Microsc., 225, 293–303  
3. C. Cremer, B. Masters, 2013, Resolution enhancement techniques in microscopy, EPJ H 38, 281

### Application to an optical microscope

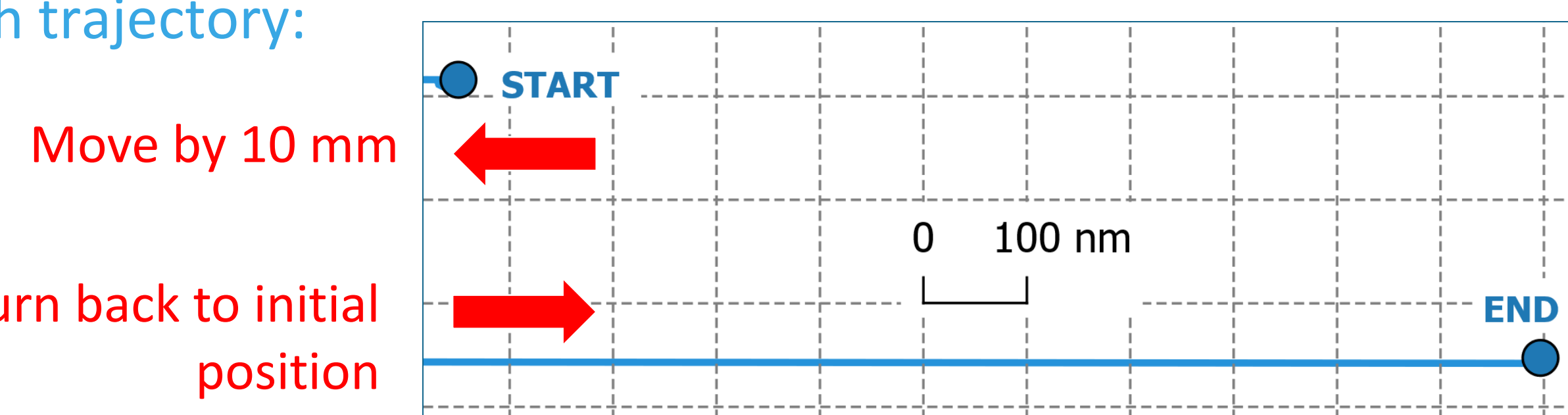
Application to a Olympus BX-41 with motorized stage.

- Drift during 20 minutes



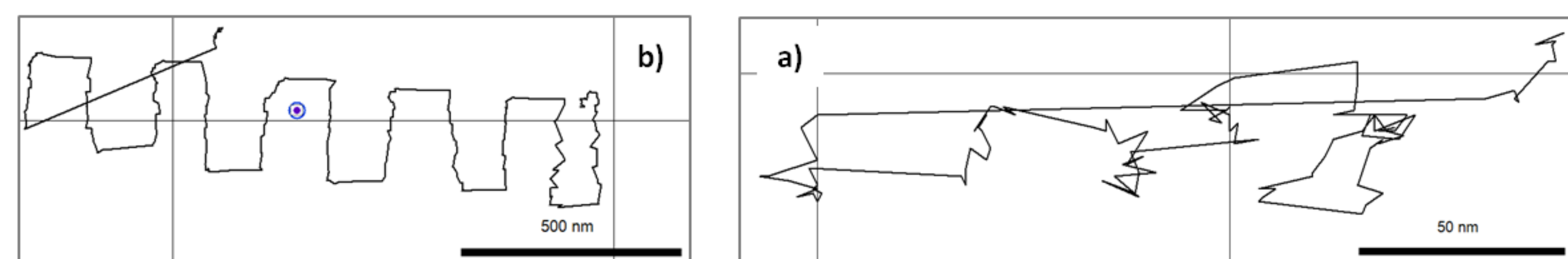
- Repositioning capability

- Gap between the recorded start and the end point after back and forth trajectory:

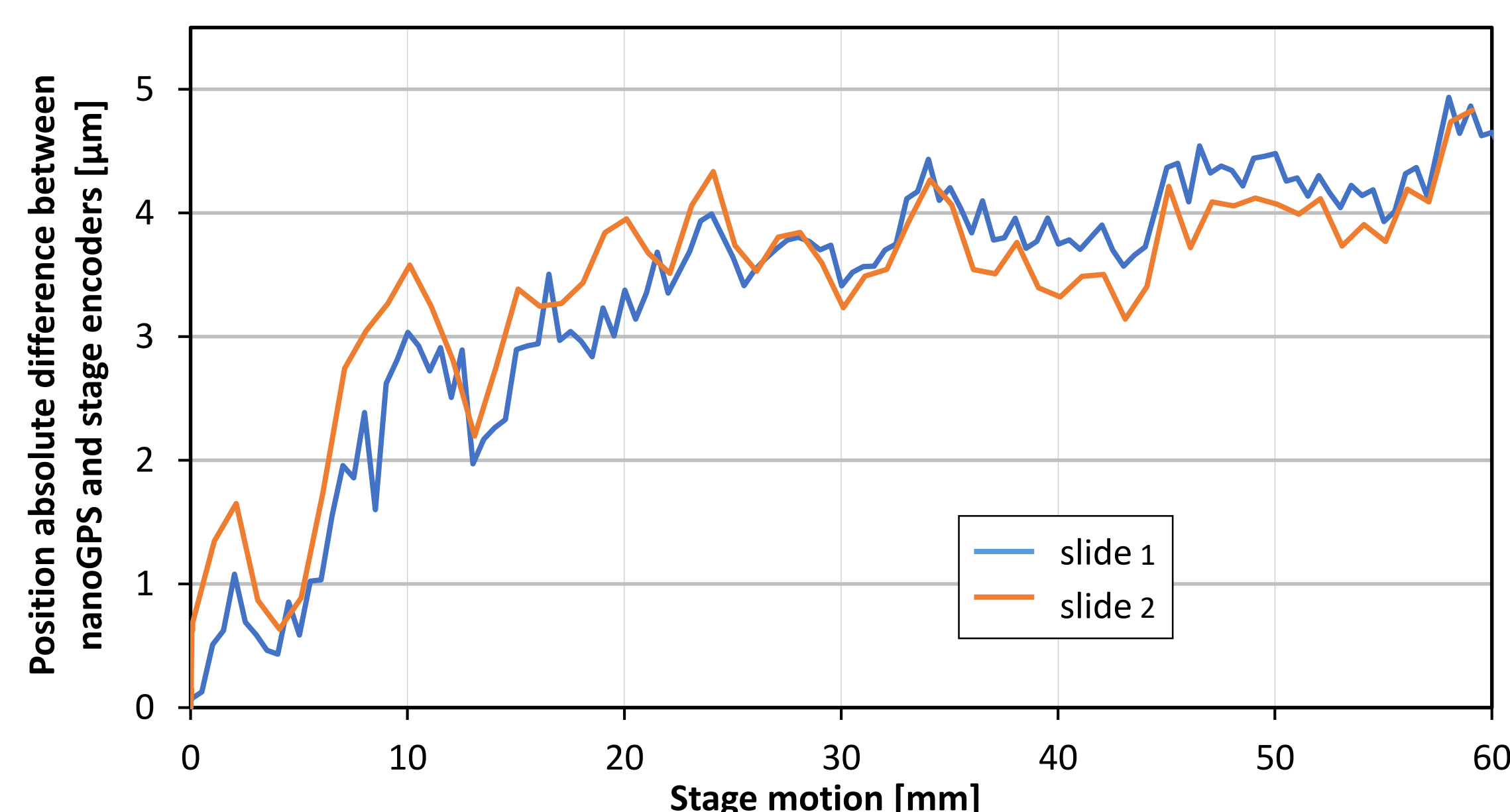


- Compliance with instrument

- Trajectories of a non closed-loop stage. The step motion target set is a) 200nm (reliable trajectory) and b) 50 nm (unreliable trajectory).



- Trajectory of the stage, assessed with different nanoGPS encoded slides in order to remove any systematic error patterns of the slides.



## Conclusion

- NanoGPS technology is a simple way to monitor displacement in context of machine vision.
- Beta commercial versions available (contact [olivier.acher@horiba.com](mailto:olivier.acher@horiba.com)). See also ICE18328, Thursday, 16h05.