Test of the Newport NSA12 stepper and M-461-XY stage

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Change Record

Issue	Date	Section/ Paragraph Affected	Reasons / Remarks	Name
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1 Scope

This document reports the results of the laboratory test of the Newport M-461-XY stage moved by the NSA12 stepper motor controlled by the MPIA MoCon. This is the solution identified in the ARGOS FDR to displace the WFS collimating lenses that recenter the pupils on the lenslet array.

2 Applicable documents

No.	Title	Number & Issue
AD 1	ARGOS_FDR_015b_Wfs.pdf	
AD 2		

3 Introduction

The Newport M-461-XY mount displaced by two NSA 12 two phase stepper motors provide a remote adjustment in XY for the three collimating lenses of the WFS. These lenses will be holded to the assembly by custom made wedged mounts (see Figure 1). The lens mounts are made of aluminium and they have different shape for the 3 WFS arms. The most trivial mount is the blue beam one (the upper one with respect to the WFS board). The dimensions of this holder are: 92mm lenght, 40mm width and 1.5mm thickness. Its total mass is around 5520mm^3*2.7g/cm^3 = 15g.

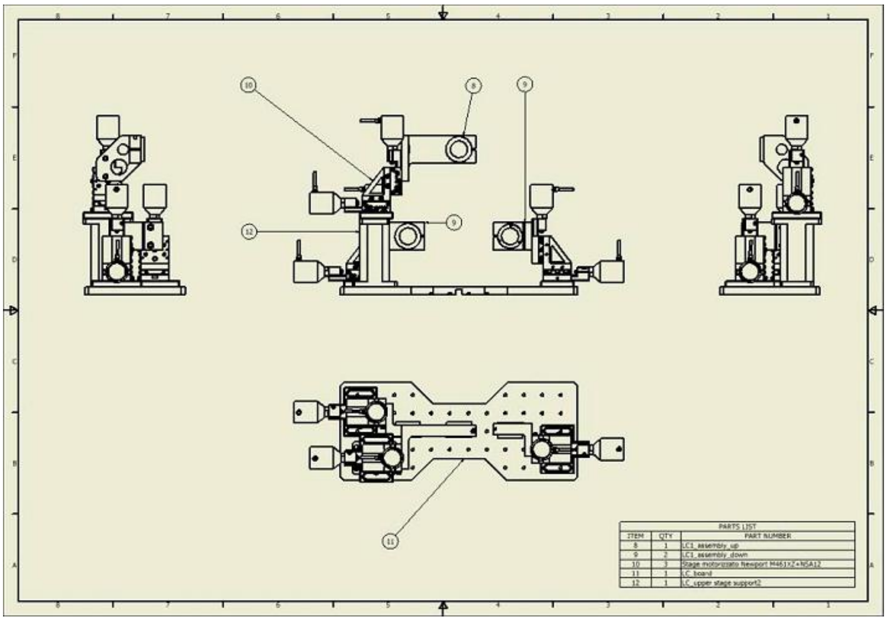

Figure 1. Mechanical drawning of the collimating lens assembly . The different solutions for the 3 WFS arms are shown.

A FEA analysis has been performed to the upper lens holder to verify that flexures don't affect alignment accuracy (the maximum deformation is <1*10^-6m on z mechanical axis with telescope pointing at zenith).

4 Stability test

In laboratory we first tested the stability of the NSA+M-461-XY assembly to validate the FEA results. The stability test was perfomed without moving the stage, but powering the motors. To simulate the lens holer we used a commercial post. The post can be simplified as a steel cylinder with 12.5mm diameter and 75mm lenght, its mass is 72g.

To test the assembly stability we used a 3D taster produced by Tesa, model Digico 11. The telescope elevation movement has been simulated using a reclining board. Figure 2 shows the test setup in the lab.

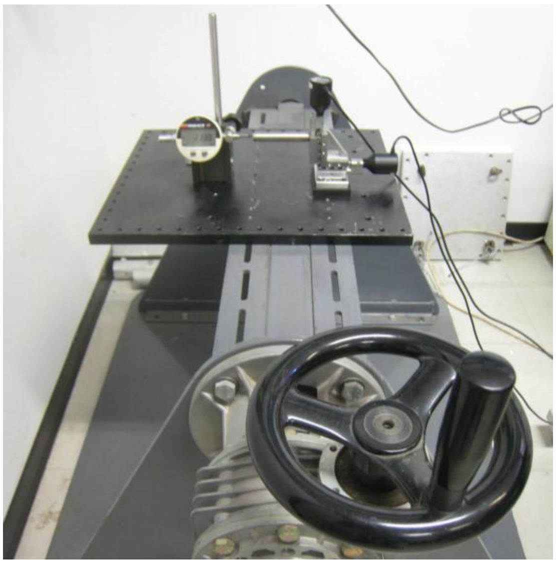

Figure 2. Picture of the reclining table on which the assembly and the taster were screwed.

To check for the 3D taster stability on the reclining table we mounted on the board a steel plate fixing it with 2 M6 screws. Figure 3 shows that the differential movement between the 3D taster mount and the steel plate is about 1micron for a 90deg rotation.

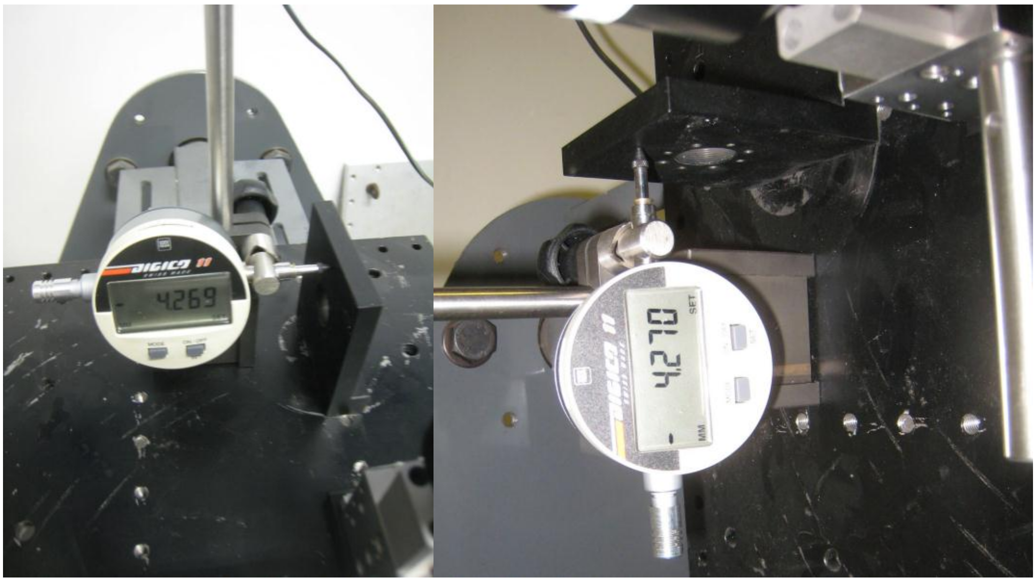

Figure 3. First check of the stability of the 3D taster mount with a steel plate fixed to the reclining table.

The test has been done sensing with the 3D taster first the top of the post screwed to the motorized assembly. The a second set of measurements has been taken sensing the plate of the Y translation stage, as shown in Figure 4.

Figure 4. points sensed with the 3D taster during the assembly stability test.

In both cases the table has been tilted by 45 and 90deg in both directions to simulate the situation of the WFS mounted at the 2 eyes of the telescope. Graph in Figure 5 resumes the differential movements between the taster and the sensed points at different elevation angles. The measurements have been repeated 5 times obtaining the same values. The maximum displacement measured is 10 microns when the table has been tilted by 90deg as showed on right in Figure 3.

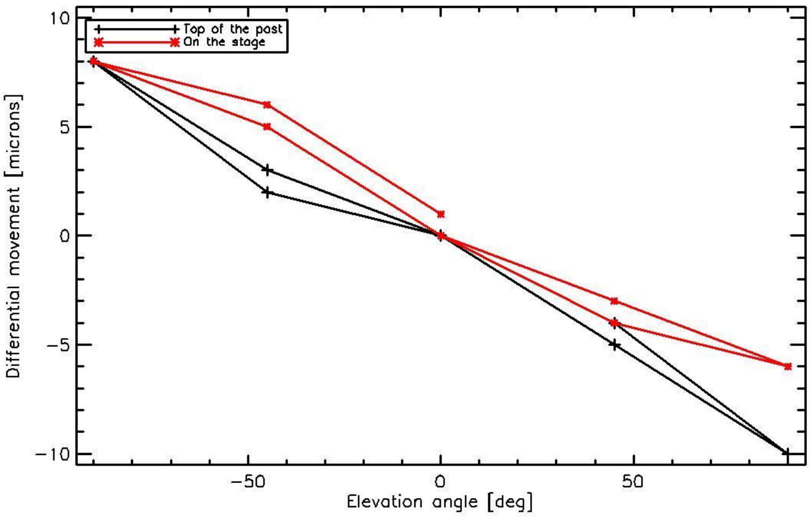

Figure 5. plot of the differential movement between the sensed points and the 3D tester in function of the inclination of the table.

5 Hysteresis and accuracy

The assembly hysteresis has been measured displacing the horizontal NSA motor, controlled by the MoCon. The effective position of the stage base has been sensed with te taster. The setup is similar to the right of Figure 4, but the whole setup has been screwed on the optical bench.

First we applied a set of millimetric steps to the motor and we measured the stage position. The commands sent to the controller vary in the 0-400-0 range at a 100 step increment. The commands can be expressed in mm by multiplying the sent value by 0.006345mm/step (see Figure 6).
The assembly doesn't show hysteresys in case of millimetric steps are applied. The accuracy in the positioning of the assemby is <10µm that is consistent with the producer specifications.

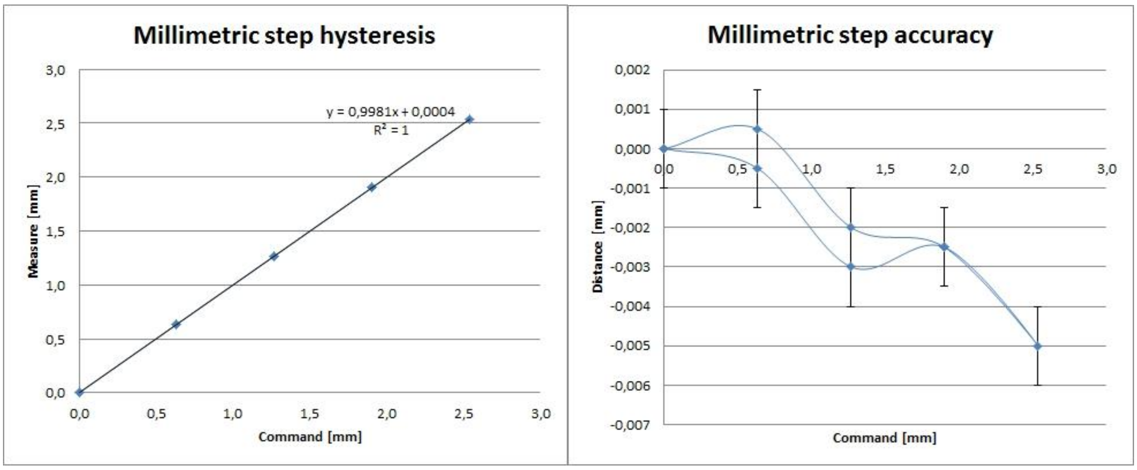

Figure 6. The plot shows the millimetric commands sent to the horizontal NSA stepper motor versus the stage position measured with the taster (left) and the distance between the 2 values (right).

Then we applied a 400 step command to the motor and we checked the assembly hysteresis when a set of steps in the 400-410-400 range are applied at 1 step increment. The measured position is plotted on left in Figure 7. The hysteresis is still negligible. The accuracy in the positioning is <5µm (see Figure 7 on right).

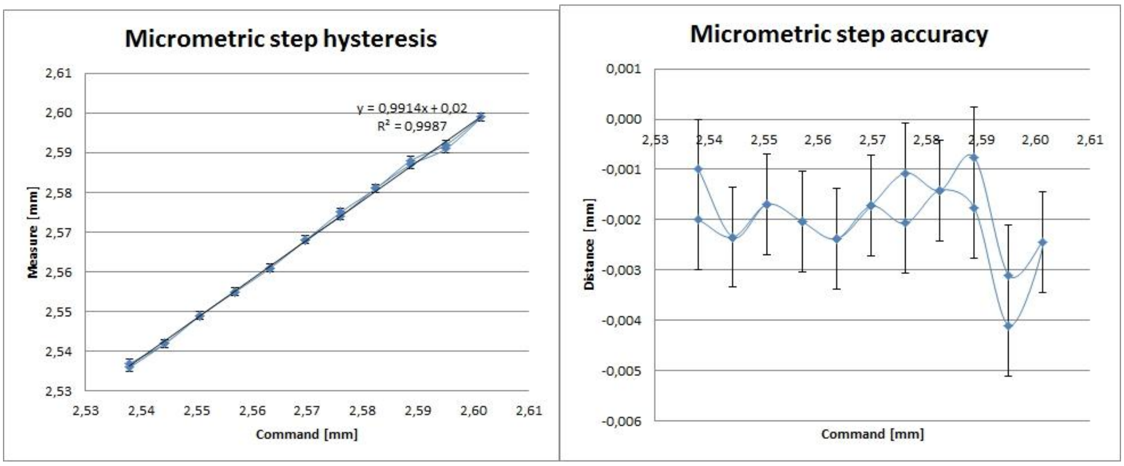

Figure 7. Plot of the hysteresis and accuracy in the stage positioning when a 400 step command is applied and the position if then varied by a single step.

6 Cold test

This test has been performed to check that the NSA12 stepper motor could work also at the environmental conditions expected at the telescope.

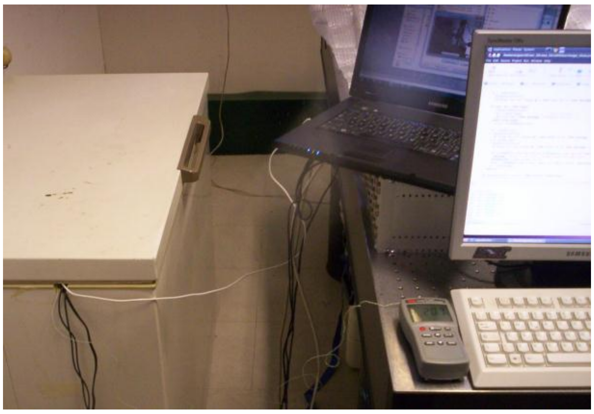

Figure 8. Picture of the hardware used in the cold test of the Newport M-461-XY stage and NSA12 stepper.

Figure 8 shows the setup used in this test. We mounted the assembly on a small board to which has ben camped also the taster. The board then was putted into the fridge and the temperature was gradually lowered to -30°C. A webcam and a lamp (see Figure 9) allowed us to read the taster (till the liquid crystal freezed at -12°C) and to check that the stage was still moving when comanded with the MoCon.

Figure 9. Image taken with the webcam when the temperature in the fridge was around 5°C.

The features checked during the test are:

- Assembly hysteresis and positioning accuracy from 5 to -12°C (see Figure 10 on left).
- Motor repeatability in the home procedure from 5 to -12°C (see Figure 10 on right).
- Motor does home procedure correctly and it moves while it is connected from -12 to -30°C.
- Motor connects and it moves for first time at -30°C while it was power-on.
- Motor connects and it moves while it was power-off for 2 hours at -30°C.

All the features were accomplished succesfully from the assembly. The accuracy in both the positioning and homing procedure are within 10µm.

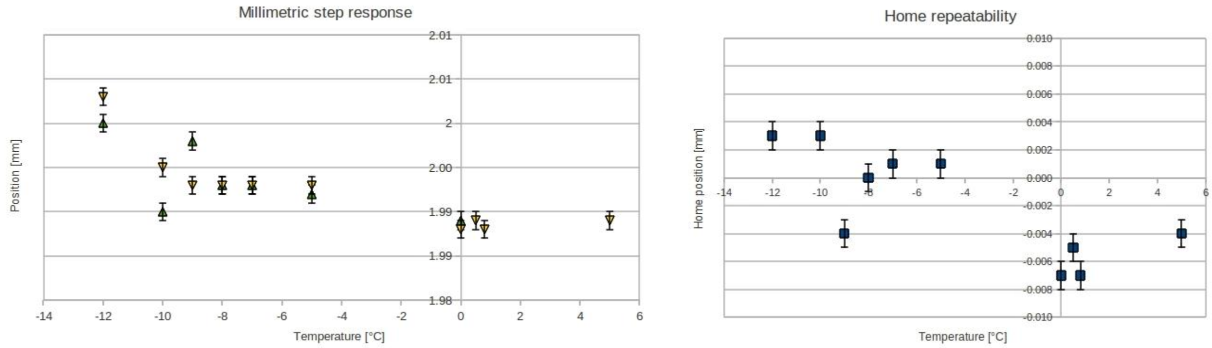

Figure 10. Left: position accuracy of the assembly in function of the temperature when a 2mm command is sent to the controller (2 set of measurements). Right: repeatability of the home procedure in function of the temperature.

7 Conslusion

The test demonstrated that the assembly of Newport M-461-XY and NSA12 stepper can be used to displace the collimating lenses in the ARGOS WFS. The displacement of this lens shifts the pupil position on the lenslet array with a 1:1 ratio. The measured 10µm of accuracy and stability of the assembly ensure a resolution and stability of 1/40 of subaperture diameter on the lenslet array.

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