WFS Lenslet Arrays acceptance test

Doc. No.	ARGOS Technical Note 110
Issue	1.0
Date	06/04/2011

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	Name	Date

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Change Record

Issue	Date	Section/ Paragraph Affected	Reasons / Remarks	Name
1.0	06.04.2011	all	created	M. Bonaglia

1 Scope.

This document resumes the meaurements done in laboratory on the 4 units of WFS Lenslet Arrays (LA) produced by SUSS MicroOptics. The measurements are aimed to confirm that the most critical features of the LA are within the specifications provided by INAF – Arcetri Observatory to SUSS.

2 Applicable documents.

No.	Title	Filename
AD 1	Technical specifications for the ARGOS WFS Shack-Hartmann lenslet array.	Lenslet_array_procurement.pdf
AD 2		

3 Introduction.

The production of ARGOS lenslet arrays have been assigned to SUSS Microptics. Table 1 resumes the specifications provided by OAA to the producer. We have received 4 units on the 21st of March 2011. They are named piece B, piece 3, piece 5 and piece 6.

Requirement	Specification
Material	Fused silica
Lens geometry	Square
Lens pitch	(384.00 ± 0.25) μm
Lens width	(376.00 ± 0.25) μm
Lens radius of curvature	6.15 mm ± 10%
Number of lenses in array	62 x 62
Array external diameter	(24.00 ± 0.05) mm
Array clear aperture diameter	(21.5 ± 0.1) mm
Surface quality	5/5 x 0.04
Wafer thickness	(1.20 ± 0.05) mm
Coating	AR, double sided, T > 99.8 % @ 532 nm

Table 1. Specifications of the SH lenslet array (from SUSS offer).

The arrays have been diced in an hexadecagonal shape and they have been glued on retaining rings of 25mm diameter. A picture of one unit of lenslet array is shown below:

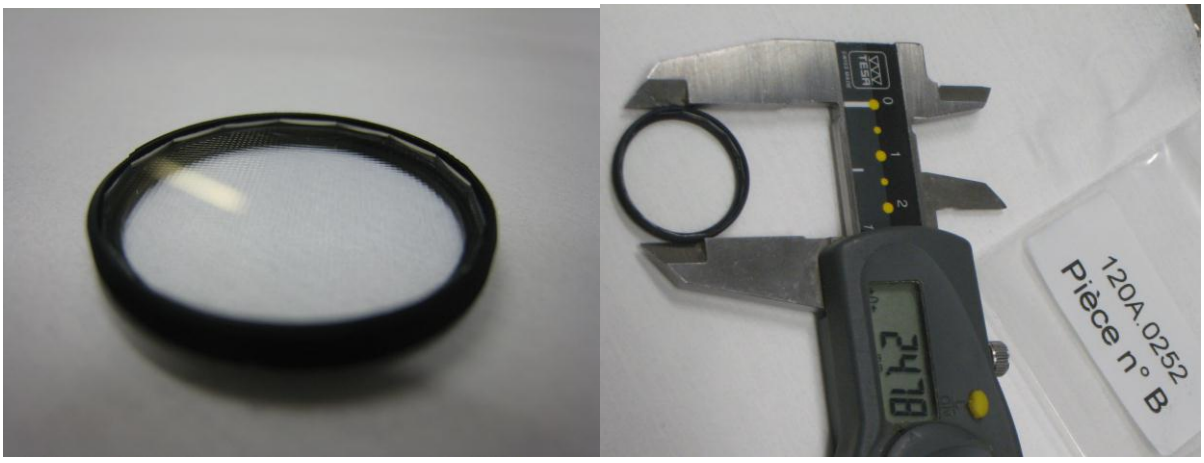

Figure 1. Left: picture of one unit of ARGOS lenslet array. Right: measurement of the external diameter of the pieces. 25mm is the upper limit to fit into the mechanical mount.

4 Measurement of lenslet pitch.

The pitch between lenses have been measured using the collimated beam generated by an interferometer (Wyko RTI 4100). The 632nm light is focussed by the lenslet array on a CCD camera (AVT/Prosilica GC1350). A picture of the measurement setup is shown below:

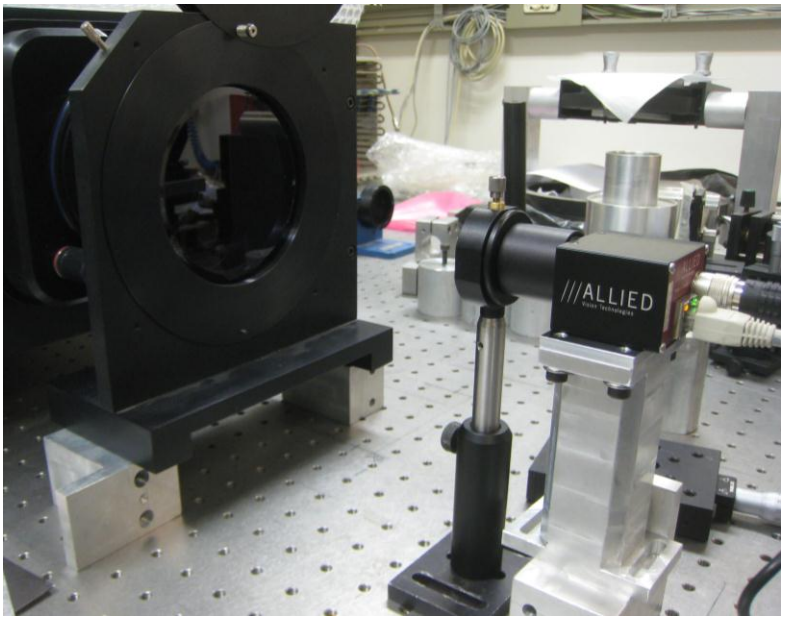

Figure 2. Picture of the setup used to test the lenslet arrays pitch.

The spot pattern of the camera is shown here, together with a cut along a row of 17 spots:

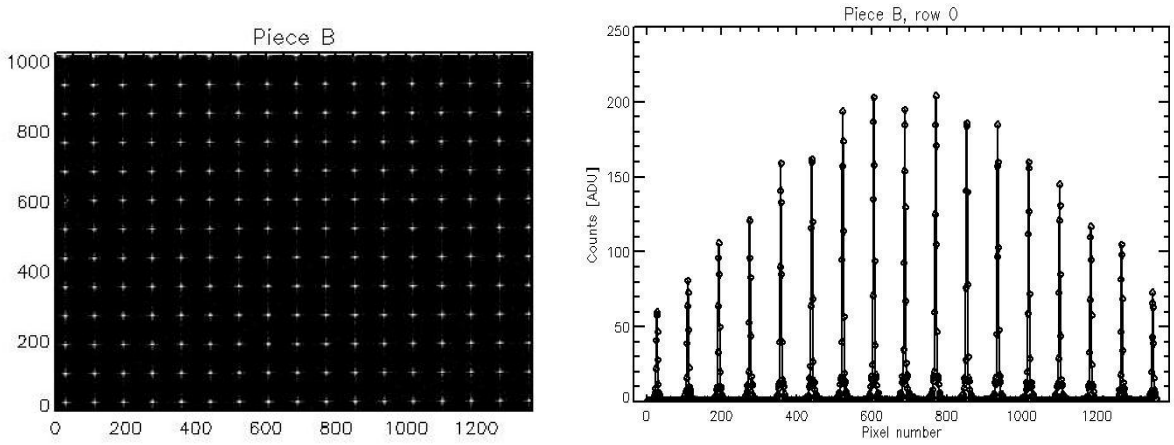

Figure 3. Up: pattern of spots generated by the first lenslet array tested. Bottom: cut along the first row of spots.

We measured the distance between the 17 spots visible on the 1360 pixels of the camera. We assume that the output beam from the interferometer is perfectly collimated, without focus term. The measure have been repeated for all the 12 rows visible in figure. The error associated to the pitch is evaluated from the rms of the 12 measurements. The camera pixel size is 4.65µm/px. The plot below resumes the results obtained, the pitches of the lenslet arrays are (384.0±0.1)µm. This value is in accordance with the specifications given to the producer.

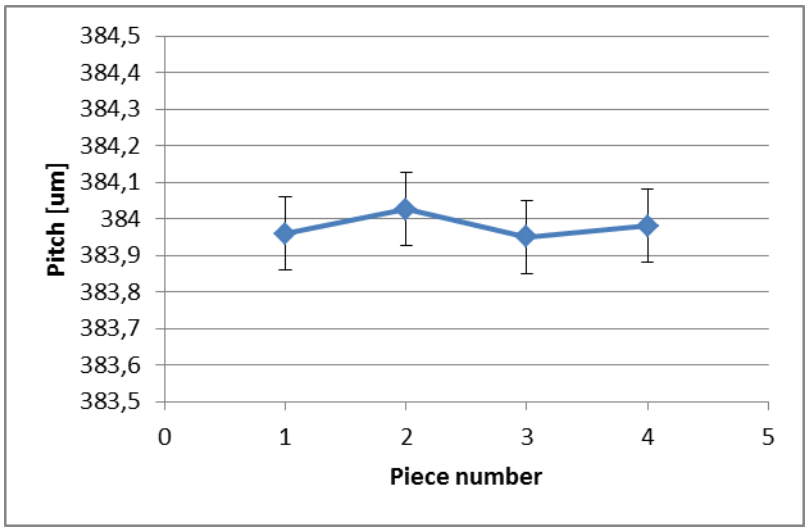

Figure 4. Plot of the pitch measurements for the 4 units of the lenslet arrays.

5 Measurement of lenslet focal length.

These measures have been done using the interferometer to generate a collimated beam. Then a flat mirror was placed on a micrometric adjustable mount. The mount was calibrated translating the micrometric screw for a range of (7.54±0.01)mm and measuring the position of the reflected beam on a reference screen (127.0±0.5mm). The distance between the mirror and the reference screen is (236.0±0.5)mm. This accounts for an optical deflection of (0.070±0.001)rad/mm.
The beam reflected by the flat mirror hits the lenslet array and the spot pattern is directly imaged on the Prosilica camera. A picture of the setup is shown in figure:

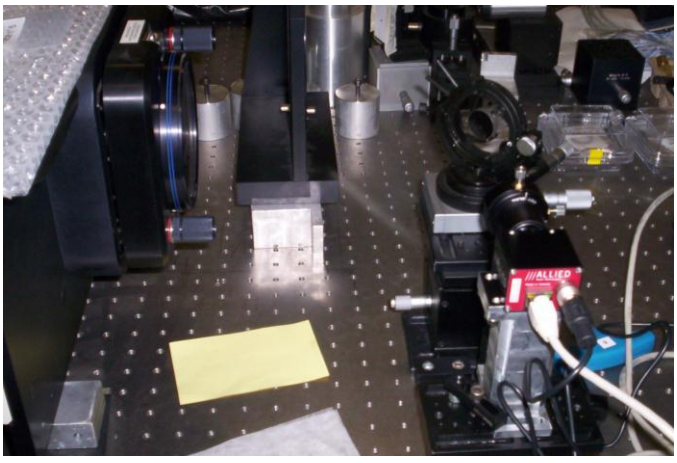

Figure 5. Picture of the setup used for the measure of the lenslet focal lenght.

The image of the spot pattern has been acquired at a reference position of the mirror and then after moving the screw by 200µm, that corresponds to an optical tilt of 0.014rad. Figure below shows the differential position of 2 spots on the CCD frame:

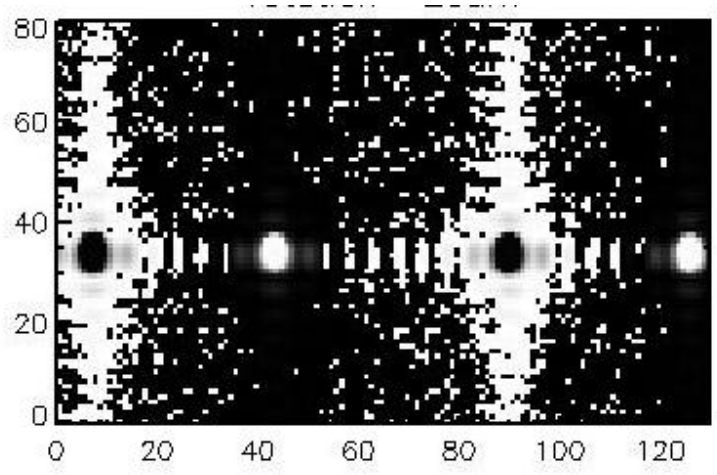

Figure 6. Differential position of 2 spots on the CCD frame when the mirror is tilted by 0.014rad. The white spot marks the reference position while the black one is the spot position after the screw is translated by 200µm.

The white spot is the original position, when the micrometer reads 0. The black spot surrounded by white pattern corresponds to the tilted mirror case. The distance between the spots is (36±1)px = 167.4µm. The focal length evaluated is (12.0±0.3)mm. This matches the specifications of the lenslet array radius of curvature required to be 6.15mm with a 10% tolerance.
These measurements have been repeated for all the 4 pieces giving the same results.

6 Inspection of the overall lenslet arrays quality.

This test has been done reimaging the lenslet array focal plane with an auxiliary lens. The magnification of the optical setup has been chosen to fit the 25mm physical diameter of the lenslet array into an area of 1000x1000px of the Prosilica. This corresponds to have a re-imaged focal plane of 4.65mm and a magnification parameter of M=0.186. As reimaging lens we used a 2" diameter 125mm focal biconvex lens. The setup is shown in Figure 7:

Figure 7. Setup used to inspect the overall optical quality of the lenslet arrays. The high-tech cardboard shield prevents the outer beam light to be focussed on the camera by the auxiliary lens.

The results of the test are shown in Figure 8, in all images 55 spots are visible. This corresponds to a clear aperture of 21.12mm, that matches the specifications. The same result has been obtained for all the other 3 lenslet arrays.

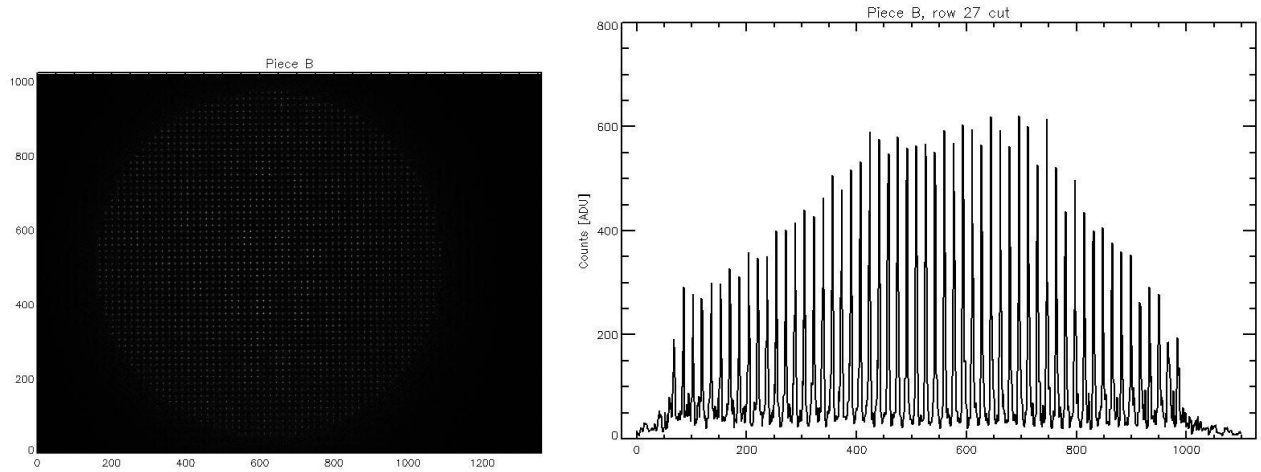

Figure 8. Left: spot pattern reimaged on the Prosilica. Right: cut through the central row of the spots. 55 peaks are visible.

7 Conclusion.

The 4 lenslet arrays ordered and produced by SUSS are in specs.

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