Aperture Partitioning Element Results

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ABSTRACT

Partitioning the pupil reduces the degree of baseline redundancy, and therefore improves the quality of images that can be obtained from the system. A practical realization of this approach uses an aperture partitioning element at an aft optics pupil of the optical system. This paper describes on-sky testing of a new aperture partitioning element that is completely reflective and reconfigurable. The device uses four independent, annular segments that can be positioned with a high degree of accuracy without impacting optical wavefront of each segment. This mirror has been produced and is currently deployed and working on the 3.6 m telescope. A comparison to a non-partitioned image will illustrate the utility of the hardware in improving image quality.

1. BACKGROUND

Several observations were made using the aperture partitioning element and a flat mirror positioned at a pupil. Both mirrors were on a linear stage, enabling observations of the same object under similar conditions. The mirrors on the stage are shown in Figure 1.

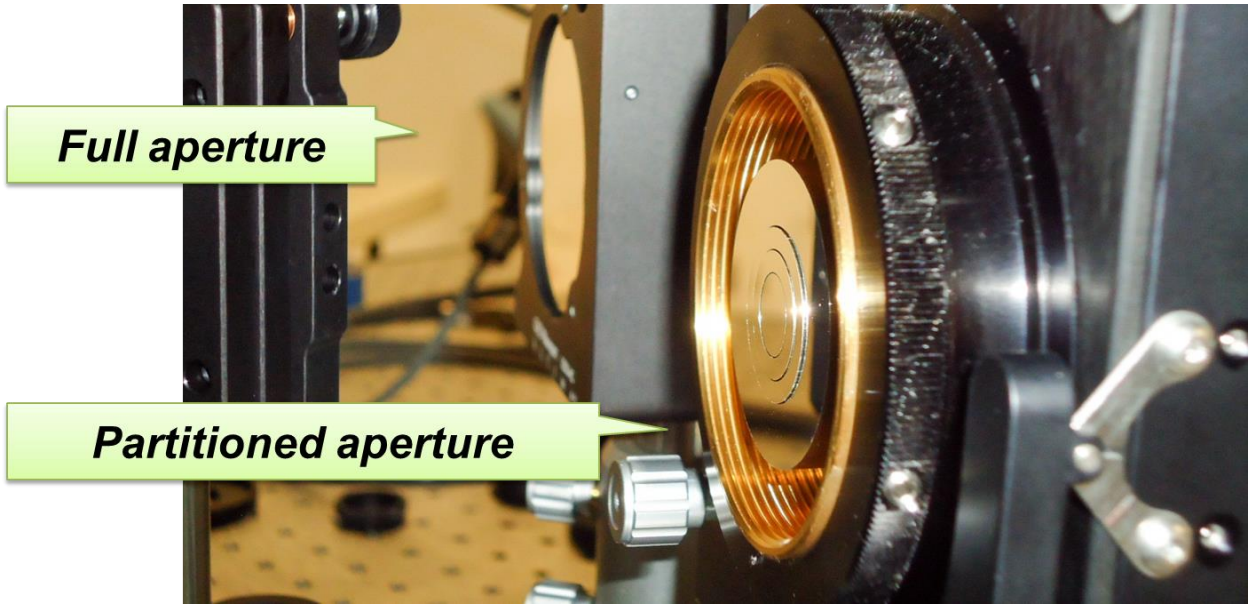
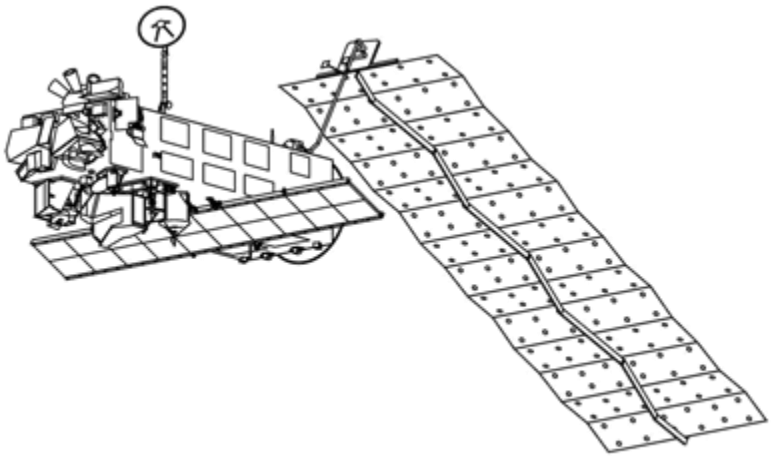


Figure 1 - Full and partitioned apertures

2. RESULTS

A typical example of an object observed is shown in Figure 2.



https://uars.gsfc.nasa.gov/uars-science/UARS_brochure/JPEGs/Satellites/ENVISAT-IN-FLIGHT.jpg

Figure 2 – Object example

The images obtained from the example shown in Figure 2 are shown in Figures 3 and 4 at ~87 degrees elevation.

Figure 3 – Single frame from flat mirror

Figure 4 – Single frame from partitioned mirror

Figure 3 is a single frame of 100Hz data taken with the sensor using an optical flat in place of the static aperture partitioning element, and Figure 4 is a single frame of 100Hz data taken with the sensor using the static aperture partitioning element. Figure 4 was taken roughly 10 seconds after Figure 3. Note that the pose of the object has remained almost the same. In Figure 4, the object appears dimmer as the light is spread over four apertures. The area of each aperture partitioning element annuli is slightly different, this is illustrated in the relative intensities of the objects in the image.

Figure 5 shows the reconstructed image from a short series of images taken along with Figures 3 and 4.

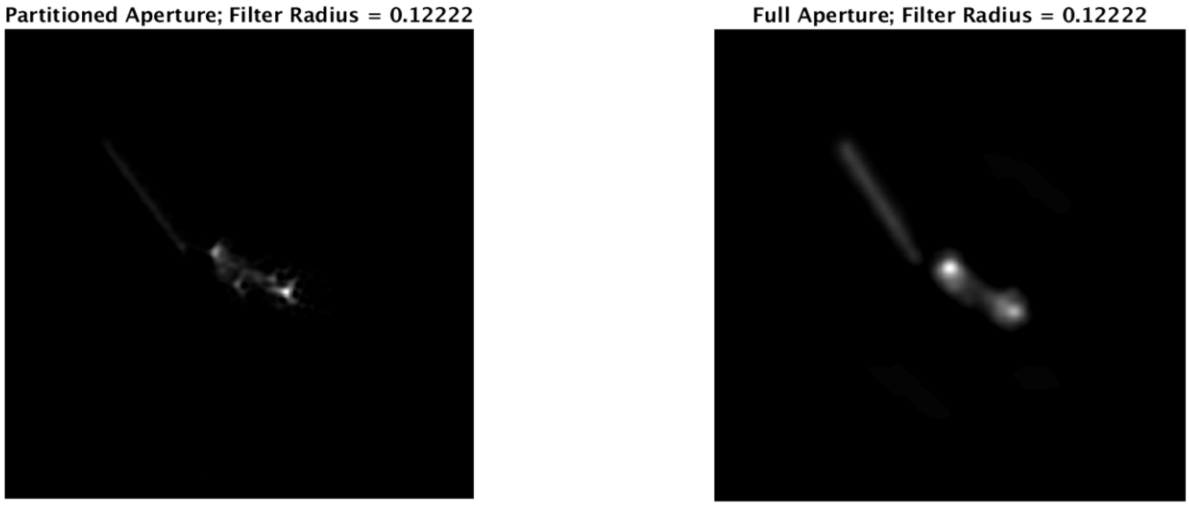


Figure 5 – Reconstructed images from partitioned and full apertures

The image formed from the partitioned aperture clearly show more detail

3. CONCLUSION

On-sky images are being collected to evaluate the effectiveness of aperture partitioning in aiding in producing better images. Preliminary results presented show the partitioned images appear to have more detail than those produced with a flat mirror.