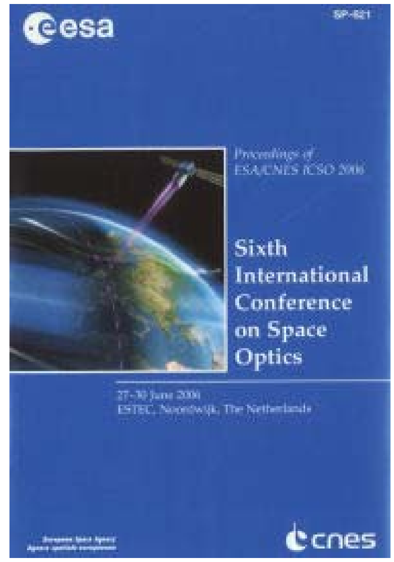
International Conference on Space Optics—ICSO 2006

Noordwijk, Netherlands

27–30 June 2006

Edited by Errico Armandillo, Josiane Costeraste, and Nikos Karafolas



MIBS breadboard ready for testing

Johan Leijtens, Bryan de Goeij, Erik Boslooper

International Conference on Space Optics — ICSO 2006, edited by Errico Armandillo, Josiane Costeraste, Nikos Karafolas, Proc. of SPIE Vol. 10567, 105671Z · © 2006 ESA and CNES
CCC code: 0277-786X/17/$18 · doi: 10.1117/12.2308107

MIBS BREADBOARD READY FOR TESTING

Johan Leijtens, Bryan de Goeij, Erik Boslooper

TNO Science and Industry, Postbus 155, 2600 AD Delft, email:johan.leijtens@.tno.nl

ABSTRACT

MIBS is a spectrometer operating in the thermal infrared wavelength region, designed in frame of the phase A study for the ESA EarthCARE mission as part of the multispectral Imaging instrument MSI, which uses a 2D microbolometer array detector in stead of the more common MCT detectors.

Utilization of a microbolometer and using an integrated calibration system, results in a sensor with a size and mass reduction of at least an order of magnitude when compared to currently flying instruments with similar spectral resolution.
In order to demonstrate feasibility a breadboard has been designed, which will be build and aligned in 2006 and will be ready for testing the forth quarter of 2006.

1. INTRODUCTION

EarthCARE is a joint European-Japanese mission addressing the need for a better understanding of the interactions between cloud, radiative and aerosol processes that play a role in climate regulation.

Fig. 1. Earthcare artists impression

The EarthCARE mission aims to improve the representation and understanding of the Earth's radiative balance in climate and numerical weather forecast models by acquiring vertical profiles of clouds and aerosols, as well as the radiances at the top of the atmosphere.

The EartCARE mission will fly four instruments, being:

- Backscatter Lidar (ATLID) - ESA High-spectral resolution and depolarisation
- Cloud Profiling Radar (CPR) - JAXA/NICT - 36 dBZ sensitivity, 500 m vertical range, Doppler
- Multi-Spectral Imager (MSI) - ESA 7 channels, 150 km swath, 500 m pixel
- Broadband Radiometer (BBR) - ESA 2 channels, 3 views (nadir, fore and aft)

Of these the MSI is the only instrument with a swath, thus providing context information.

During the phase A study period there have been two parallel teams studying concepts for the Earthcare satellite.

Within both teams, the MSI instrument is split into two sections:

- Visible Near- and Short wave infrared (VNS)
- Thermal infrared.(TIR)

Due to mass and size restraints, the TIR instruments use microbolometer detectors as the prime sensing elements.

During the phase A study for which an extension is still running, two teams (one lead by Astrium, the other by Alcatel) have performed a preliminary design for both the mission and the instruments.

TNO Science and Industry (formerly TNO TPD) has taken part in this study as the prime contractor for the Multispectral Imager instrument as part of the Astrium team.

2. MICROBOLOMETER SPECTROMETER MIBS

Within the Astrium team, TNO has designed a novel concept for the Thermal infrared channels.
Fig. 2. depicts the result of the phase A study as presented in the final report.

Proc. '6th Internat. Conf. on Space Optics', ESTEC, Noordwijk, The Netherlands, 27-30 June 2006 (ESA SP-621, June 2006)

The smaller section contains the VNS channels, and the larger section is the so called microbolometer spectrometer.

A number of years ago, this concept couldn't give a high enough NETD in order to be feasible for monitoring of low temperature targets.

However, continuous performance improvements in obtainable noise levels for microbolometers (that are still going on) have led to the availability of bolometer detectors that could fulfill and even exceed the requirements of MSI while using the spectrometer concept.

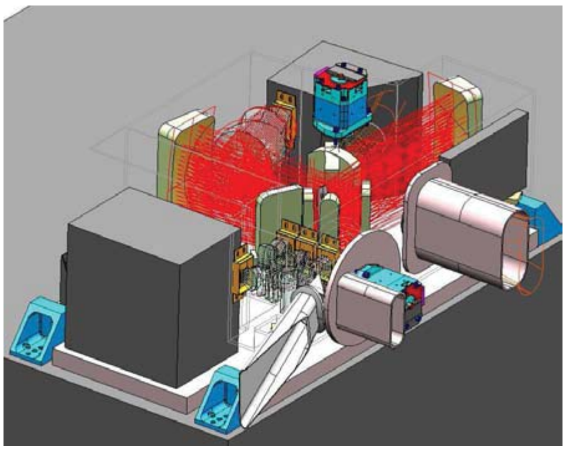


Fig. 2. Phase A MSI instrument

Because these improvements are mainly driven by military applications within the USA, ITAR restrictions will be a main problem in obtaining these detectors, but due to the fact that microbolometers are also finding their way in things like automotive safety it is very likely that improved detectors will be available within the foreseeable future from sources outside of the USA.

Although spectrometers have a radiometric disadvantage as compared to the more conventional beamsplitter operated systems (which is disputable for instruments with more than 2 channels) the main advantage is the higher spectral purity and the larger number of channels that can be provided at the same or marginally increased costs.(some extra signal processing electronics might be needed for the instrument control unit, and at satellite level more data will need to be handled.)

Although extensive modeling has been performed, it was decided to build a breadboard to show the feasibility of the concept.

The breadboard will closely resemble the final instrument, apart from the facts that it will not be light weighted and will operate at room temperature.
The main assemblies (slit assembly and camera assembly) as well as the mirrors are all highly similar to the foreseen flight configuration.
The breadboard therefore, can easily be converted into a flight capable instrument through exchange of the pointing mirror assembly, the cold blackbody and the detector. (if necessary the optical bench can be light weighted also)

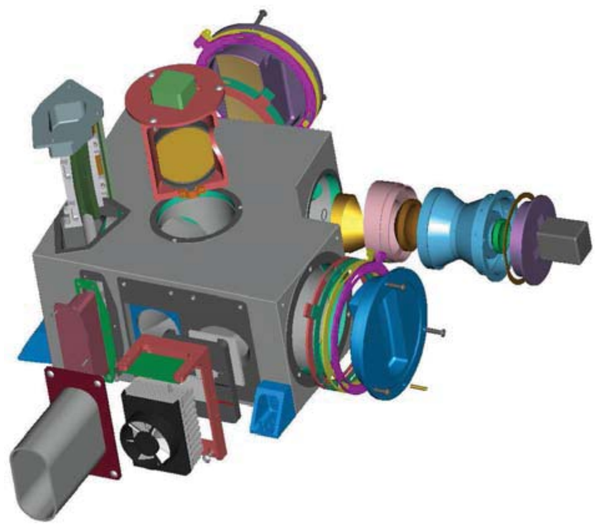


Fig. 3. Mechanical setup MIBS

Currently the parts to be used for the breadboard have been ordered and are under production.
As can be seen in the following pictures, some are already nearing completion.

It is the intention of TNO to assemble the breadboard before the end of the year and do some first order characterization measurements.

The aim of this project (which is supported by the Dutch NIVR) is to show that the final instrument can meet the requirements as posed on the EarthCARE MSI instrument once the foreseen detectors are available.

CONCLUSION AND ACKNOWLEDGEMENT

The production of parts for MIBS is on the way and at schedule.

We would like to thank NIVR for their support to this program, allowing the demonstration of what may be a new bread of thermal infra red instruments.

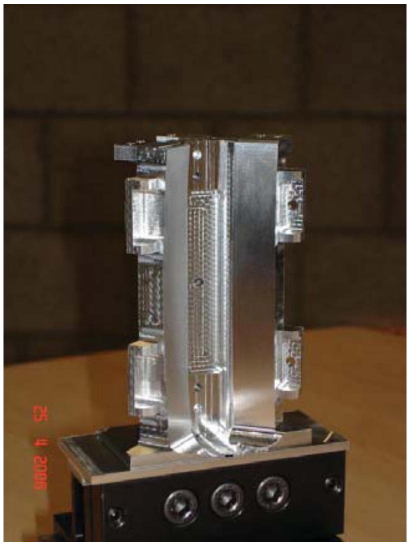


Fig. 4. Slit assembly central part

Fig. 5. Slit assembly folding mirror

Fig. 6. Camera housing

Fig. 7. Collimator mirror blank

Fig. 8. Pointing mirror blank

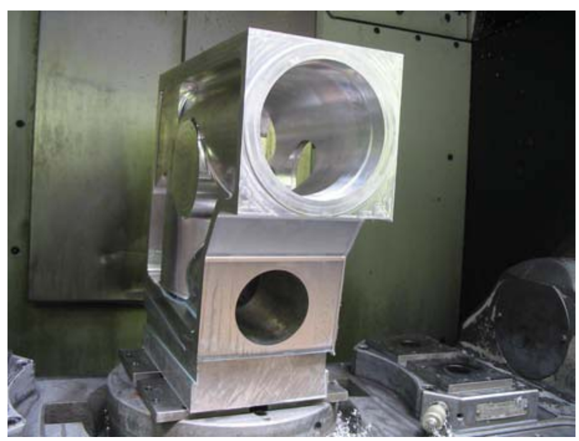


Fig. 9. Main body