

BOUNDARY LAYER TRANSITION DETECTION BY INFRARED (IR) IN S2MA

IR transition detection objectives

With the IR technique, the state of the boundary layer can be determined permanently.

IR application

GMT is equipped with 2 high resolution (640x512) IR cameras:

- 1 camera working in the range 2.5 – 5 μm (IR band II), available with 3 IR lenses of 12, 27 and 54mm.
- 1 camera working in the range 8 – 9.4 μm (IR band III), available with 3 IR lenses, 25, 50 and 100mm. This camera allows precise measurements of temperatures close to the stagnation temperature with short exposure time ($\sim 20\mu\text{s}$).
- For specific needs, additional cameras can be borrowed to other Onera departments.

Preparation

Specific model preparation is required for IR measurements. The best results are obtained by including insulating inserts of about 1mm of thickness. Model coating with a paint thickness of at least 100 microns is also possible.

IR cameras have to be kept at atmospheric pressure. Specific windows have to be used to allow IR measurements. 3 Windows of 127, 150 and 240 mm in diameter, suitable for the range 2.5 - 5 μm are available, as well as 3 windows for the 8 - 9.4 μm range.

For each test, mounting of the camera has to be defined depending on the model mounting (full or half model) and on the field of view to be observed.

Camera adjustment requires 0.5 hour per camera inside the test section.

Testing

To obtain images with enough sharpness, the model has to be kept in thermal imbalance. In S2MA, this can be achieved very easily by changing the mass flow of the cooling system.

Results

The IR system has its own independent data acquisition system. IR images are available on line.

Resolution

Thermal resolution is about 0.1°C.

Spatial resolution is given by the combination of lens and CCD. Field of view at 1m is respectively:

- band II camera : 0.8m, 0.4m and 0.2m respectively for 12, 27 and 54 mm lenses
- band III camera : 0.4m, 0.2m and 0.1m respectively for 25, 50 and 100 mm lenses

Limitations

IR observation is only suitable for surfaces having an angle $< 60^\circ$ between the normal to the surface and the viewing axis.