A SOUTH AFRICAN INITIATIVE FOR PRE-FLIGHT RADIOMETRIC CALIBRATION OF SATELLITE IMAGERS

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ABSTRACT

Internationally, the remote observation of Earth is rapidly maturing alongside the need for higher accuracy in radiance measurements. Accuracy of, and confidence in Earth radiance measurements is vital for applications such as climate change analysis and the forecasting and detection of natural hazards. The radiance accuracy depends on pre-launch calibration of the observing instruments and continuous post-launch sensor assessment. South Africa, a country on the brink of taking a giant leap into space [1], may soon be one of the leading countries with a facility for spectral irradiance and radiance calibration of satellite imagers.

The country's Department of Science and Technology (DST) has commissioned the Council for Scientific and Industrial Research (CSIR) to establish a calibration facility at Houwteq, which is nestled in the mountains on the outskirt of Cape Town. The facility is presently designed to calibrate a SunSpace linescan charge-coupled-device (CCD) imager and can be rearranged to meet other calibration needs.

This facility consists of a 1 m internal diameter uniform source integrating sphere for absolute radiance measurements and a 4 grating turret monochromator system for the relative spectral irradiance calibration. The system has a computer based model. The beam imaging, collimating and analysis is done with a ZEMAX optical system design program. Calculation of the radiance and flux throughput is done using a Matlab R2008b computation software package.

The monochromator system is unique in the sense that it incorporates a relatively uniform light input, has a grating selection for improved efficiency and meets the required throughput level. The quasi-monochromatic output is depolarized and then reflected off custom made mirrors such that the final collimated beam overfills the imager's 280 mm aperture. A calibrated silicon detector is used as the reference standard. The system has a spectral range from 400 nm to 900 nm and the coverage maybe extended to the ultraviolet and infrared if needed. The spectral resolution can be varied and is currently set for 2 nm or 4 nm depending on required throughput.

The absolute radiance system consists of the large integrating sphere, a set of color temperature matched halogen lamp assemblies for radiance variability, and a calibrated reference spectroradiometer. The system will be tested for exit port uniformity. Calibration of the imager will include the absolute radiance response and linearity.

It is expected that the total combined uncertainty (k=2) for spectral irradiance will be less than 5%. Some uncertainty contributors are source stability, polarization, and environment stability. The absolute radiance depends in large on the accuracy of the reference spectroradiometer. These instruments have typical uncertainties in the margin of 3% to 10%, depending on instrument choice.

The above described South African facility for the pre-flight calibration of satellite imagers will contribute in the building of resident space capacity. Local expertise is also involved in projects for continuous post-launch sensor assessment. Between the facility and the latter mentioned initiatives there can be quantitative confidence in Earth radiance measurements with locally calibrated space instruments.

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REFERENCES

[1] CSIR Communication, *Space Science and Technology*, Vol. 3, No. 2, October 2009