Wednesday, September 23, 2020 | 2:15 p.m.

Technical Session

Equipment, Capabilities, and Facilities for Radiometric Calibration

Hardware and resources to support National and international requirements for radiometric calibration of remote sensing instruments, including long-term trending and performance enhancements of existing facilities.

- Design, characterization, and validation of test and calibration equipment, facilities, test chambers, and scene simulators (Earth, solar, and other objects)
- Scene generation and projection for hardware-in-the-loop (HIL) testing
- Specialized measurement equipment (spectral, polarization, and other)
- Long- and short-term accuracy and precision of data sources used for validation, including models
- Novel techniques, algorithm technologies, and processes to support and enhance the way we approach radiometric calibration

2:20

A Generalized Combinatorial Technique for Linearity Calibrations Applied to Optical Detectors and Spectrographs

Howard Yoon – National Institute of Standards and Technology (NIST)

ABSTRACT: For many quantities, indicating instruments are calibrated only at a limited number of values, and the extension of the calibrations to higher or lower values must rely upon the linearity of the instruments. A method for calibrating or determining the linearity of instruments that exploits the combinatorial properties of a set of different-valued, and mostly uncalibrated, artefacts is described. The presentation describes the underlying principles of the method, its limitations, and examples of the application of the method to very different quantities: mass balances, resistance bridges, optical detectors and spectrographs. The resulting uncertainty due to linearity can be assigned from the residuals of the fitted functional form of the linearity function to the measured signals.

The implementation of this combinatorial method with the NIST Beamconjoiner apparatus is described, and calibrations of visible and infrared photodiodes, and spectrographs for internal and external customers are shown. This method is shown to be capable of determining linearities in the visible and infrared wavelength region to uncertainties of 200 ppm or 0.02 % (k=2). Linearities of spectrographs at a set integration time and as a function of integration times can be measured using this approach. Experimental setups to characterize focal plane arrays placed in cryo-vac chambers will be discussed.

2:40

Characterization of Fluorescence from the GLAMR 30” Integrating Sphere

Brendan McAndrew, Joel McCorkel – NASA Goddard Space Flight Center; Julia Barsi, Yigit Aytac – Science Systems and Applications, Inc. (SSAI); Tim Shuman – Fibertek

ABSTRACT: The Goddard Laser for Absolute Measurement of Radiance (GLAMR) has been used to provide spectral and radiometric calibration data for several earth science instruments, including the Joint Polar Satellite System (JPSS) -2 and -3 Visible and Infrared Radiometer Suite (VIIRS). Analysis of data collected by both VIIRS instruments has suggested the presence of fluorescence emitted from the GLAMR integrating sphere when illuminated by visible and ultraviolet light. This takes the form of an unexpected out of band response below 550 nm in several VIIRS bands that is in addition to interband electronic crosstalk. The VIIRS spectral response is also characterized by a monochromator which does not replicate the higher out-of-band response but has reduced dynamic range.

As a result of the VIIRS data analysis, additional characterization of the GLAMR integrating sphere have been performed specifically to check for fluorescence in the visible and near infrared range by illuminating the sphere with visible and near ultraviolet monochromatic light. The broad band spectrum of radiance generated by the integrating sphere is measured using a calibrated spectroradiometer at 3 nm spectral resolution with high SNR at a factor of 10-4 of the radiance of the primary illumination wavelength. This allows for out of band characterization

down to the noise floor of previous VIIRS testing. This spectrum is correlated with the VIIRS data sets as well as other instruments calibrated using the same integrating sphere. Prior instrument data also allows some check of the stability of the fluorescence signal over time. The characterization of the fluorescence will allow it to be accounted for in analysis of flight instrument spectral responses and improve the overall accuracy of the GLAMR characterization.

3:00

Initial Results of FLARE Network Vicarious Calibration Method

Christopher Durell, Brandon Russell, Dan Scharpf, Jeff Holt, Will Arnold – Labsphere, Inc.; David Conran – RIT; Stephen Schiller – Raytheon, Inc.

ABSTRACT: Labsphere has created automated vicarious calibration sites using the SPARC mirror technology in the new FLARE network. A short introduction to the FLARE network will be given. This paper will describe the system construction, function and implementation of the initial sites. Campaign information for small and large satellites were carried out and results of these events will be cataloged. Uncertainty models and data has been evaluated against Landsat 8 and Sentinel 2A and 2B and preliminary results will be presented.

3:20

Development of a Collimated Large Area Uniform Light Source for the Measurement of Solar Diffuser BRDF in Support of NASA Satellite Instrument Programs

Jinan Zeng – Fibertek, Inc. at NASA Goddard Space Flight Center

ABSTRACT: We report the development of a collimated large area uniform light source, which is used to acquire diffuser BRDF measurements in support of the pre-launch calibration of NASA Earth observing satellite instrument. In accordance with the goal of “testing as you fly,” this large area light source permits the measurement of diffuser BRDF using illumination geometrically similar to that realized on orbit. In the design and testing of this source, several approaches using different light sources and collimating optics were examined with the overarching goal of producing a monochromatic, unpolarized large area, uniform, collimated beam with sufficient throughput power to enable BRDF to be measured. The major components of the collimated large area uniform light source employ a series of high-power LEDs from UV-VIS to SWIR with or without an integrating sphere. Light from this source is coupled to either a 30.48 cm diameter size off-axis parabolic mirror (OAP) or a 45.72 cm diameter spherical concave mirror. A large beam uniformity evaluation system employing a scanning detector was used to measure light source uniformity. In this presentation, we describe our approaches to produce large area uniform solar diffuser illumination, and discuss potential technical difficulties. Since technical challenges exist in achieving the 1% uniformity in a collimated large area light source, we also propose a correction method to mitigate non-uniformity using a laser scan method. The characterization of the collimated large area uniform light source and preliminary BRDF results are presented.