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Chapter 4

Uncertainties in Plaque Standards

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ABSTRACT

The experiments conducted to estimate the uncertainties associated with the use of plaque standards involved calculating the reflectances of seven plaques using SXR measurements and the calibrated irradiance provided with the lamp standard, which were then compared to the reflectances provided with each plaque. The average uncertainties between the calculated and calibrated reflectances showed a range of 1.0–3.2%. With the exception of the gray plaque (T007), maximum uncertainties occurred in the blue part of the spectrum, and minimum uncertainties in the red. The importance of bidirectional effects was determined by comparing the SXR plaque measurements made from two different sides of a plaque, but with the same viewing geometry. The smallest uncertainties were associated with T005 (the NIST PTFE plaque), and the largest with T007 (the gray plaque), 0.3 and 2.1%, respectively. All of the other plaques had RPD values which fell into a narrow range with the same spectral dependence and an overall average RPD of approximately 1.0%. Plaque uniformity improved with all increases in the lamp-to-plaque distance. Regardless of the lamp-to-plaque distance, there was a constant offset of approximately 20 mm in the vertical (z) direction between the maximum signal and the center of the plaque for all the lamps; some of the lamps also showed offsets in the horizontal (x) direction.

4.1 INTRODUCTION

Three experiments were conducted to examine the uncertainties associated with using plaques during calibrations. The first involved using a NIST reflectance standard and the SXR to estimate the uncertainties in using Labsphere (Spectralon) plaques, the second estimated the importance of bidirectional effects by comparing calibrations from two different sides of a plaque, but with the same viewing geometry, and the third used a mapping radiometer to estimate the uniformity of Labsphere plaques illuminated with the same FEL lamp.

4.2 PLAQUE UNCERTAINTIES

This experiment was designed to estimate the uncertainties in plaque standards by comparing the calculated reflectance of a number of different plaques illuminated

with a single NIST standard lamp. The reflectance of each plaque was calculated using the SXR measurements and the calibrated irradiance provided with the lamp. The calculated reflectances were then compared to the reflectances provided with each plaque.

4.2.1 Equipment

The equipment used for determining the uncertainties in plaque standards involved the following:

- Satlantic Optronic Lamp F-539 (L003);
- NIST plaque K299 (T005);
- The SeaWiFS gray (10 in) plaque 24328 (T007), the JRC white (18 in) plaque 22463 (T004), the new Satlantic white (18 in) plaque 05816 (T001), and the two old Satlantic white (18 in) plaques 13172 (T002) and 01873 (T003);