NEXT-GENERATION EARTH RADIATION BUDGET INSTRUMENT CONCEPTS

by

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(ABSTRACT)

The current effort addresses two issues important to the research conducted by the Thermal Radiation Group at Virginia Tech. The first research topic involves the development of a method which can properly model the diffraction of radiation as it enters an instrument aperture. The second topic involves the study of a potential next-generation space-borne radiometric instrument concept.

Presented are multiple modeling efforts to describe the diffraction of monochromatic radiant energy passing through an aperture for use in the Monte-Carlo ray-trace environment. Described in detail is a deterministic model based upon Heisenberg's uncertainty principle and the particle theory of light. This method is applicable to either Fraunhofer or Fresnel diffraction situations, but is incapable of predicting the secondary fringes in a diffraction pattern. Also presented is a second diffraction model, based on the Huygens-Fresnel principle with a correcting obliquity factor. This model is useful for predicting Fraunhofer diffraction, and can predict the secondary fringes because it keeps track of phase.

NASA is planning for the next-generation of instruments to follow CERES (Clouds and the Earth's Radiant Energy System), an instrument which measures components of the Earth's radiant energy budget in three spectral bands. A potential next-generation concept involves modification of the current CERES instrument to measure in a larger number of wavelength bands. This increased spectral partitioning would be achieved by the addition of filters and detectors to the current CERES geometry. The capacity of the CERES telescope to serve for this purpose is addressed in this thesis.

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