

Correlated- k based fast, accurate bandpass radiance and transmittance calculations for hyperspectral and multispectral scenes

Prabhat Acharya^{*a}, Alexander Berk^a, Raphael Panfili^a, Steven M. Adler-Golden^a, Alan Wetmore^b and Richard Shirkey^c

^aSpectral Sciences, Inc., Burlington, MA

^bArmy Research Laboratory, Adelphi, MD

^cArmy Research Laboratory, White Sands Missile Range, NM

ABSTRACT

The ability to rapidly calculate at-sensor radiance over a large number of lines of sight (LOSs) is critical for hyperspectral and multispectral scene simulations and look-up table generation, both of which are increasingly used for sensor design, performance evaluation, data analysis, and software and systems evaluations. We have demonstrated a new radiation transport (RT) capability that combines an efficient multiple-LOS (MLOS) multiple scattering (MS) algorithm with a broad-bandpass correlated- k methodology called k URT-MS, where k URT stands for correlated- k -based Ultra-fast Radiative Transfer. The MLOS capability is based on DISORT and exploits the existing MODTRAN-DISORT interface. k URT-MS is a new sensor-specific fast radiative transfer formalism for UV-visible to LWIR wavelengths that is derived from MODTRAN's correlated- k parameters. Scattering parameters, blackbody and solar functions are cast as a few sensor-specific and bandpass-specific k -dependent source terms for radiance computations. Preliminary transmittance results are within 2% of MODTRAN with a two-orders-of-magnitude computational savings. Preliminary radiance computations in the visible spectrum are within a few percent of MODTRAN results, but with orders of magnitude speed up over comparable MODTRAN runs. This new RT capability (embodied in two software packages: k URT-MS and MODTRAN- k URT) has potential applications for remote sensing applications such as hyperspectral scene simulation and look-up table generation for atmospheric compensation analysis as well as target acquisition algorithms for near earth scenarios.

Keywords: k URT, k URT-MS, Correlated- k , DISORT, Multiple Scattering, Look-up-tables, MODTRAN, MODTRAN- k URT, Hyperspectral and Multispectral Scene Simulation

*prab@spectral.com; phone 781 273-4770; fax 781 270-1161; www.spectral.com