Math and Statistics Numerical Mathematics

Hyperspectral Atmospheric Compensation Through Clouds and Aerosols with Physics-Based Radiative Transfer Algorithms

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Abstract: Current concepts for the employment of Hyperspectral Imagers (HSI) for surveillance assume nearly ideal atmospheric viewing conditions. In reality clouds and aerosols will be important considerations for military operations. In the presence of optically thick clouds, visible and IR measurements provide virtually no information about what is occurring below the clouds. However, the situation is different for thin cirrus clouds and tenuous aerosol plumes, where energy from the surface is transmitted through the obscurant to the observing platform. Being able to operate with atmospheric opacities of 1 (^30% additional extinction due to thin clouds or aerosols) with appropriate S/N ratios will increase the effective operational capabilities dramatically. This will be especially important for satellites and UAV's operating over tactical domains. The Air Force Research Laboratory has recently developed new multispectral cloud and aerosol analysis techniques which, along with algorithms to maximize the atmospheric signatures, make it possible to sufficiently characterize the optical properties of transmissive cirrus and assorted aerosols. In conjunction with evolving atmospheric compensation tools, these techniques will potentially allow increased analysis of hyperspectral surveillance data in the presence of realistic contamination. Recent and proposed enhancements to the SERCAA and MODTRAN algorithms can be used to quantify the effect of clouds/aerosols on system performance. In particular, new algorithms to retrieve radiative, microphysical, and optical properties are being exploited to more fully characterize the required inputs for the radiative transfer codes including FLAASH, a developing atmospheric compensation algorithm. Additionally, spatial extent of such obscurants can be exploited using cross-pixel analyses.

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