Thermal Correction of VIR Hyperspectral Data for Ceres: Bayesian Approach for simultaneous Paramter Estimation

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Abstract

We present a method to simultaneously estimate surface temperature and spectral emissivity from hyperspectral radiance measurements obtained by the VIR instrument onboard NASA's *Dawn* mission during the HAMO phase at Ceres. The dataset spans the visible–infrared region (0.25–5.1 μm) with a spatial resolution of ∼0.38 km/pixel. Estimating surface temperature from radiance is an underdetermined problem, as it requires determining $N+1$ unknowns from N equations. Previous approaches often imposed fixed emissivity assumptions to retrieve temperature first. Here, we employ a Bayesian framework that allows simultaneous estimation of temperature and emissivity without prior fixed values. Our two-step strategy begins with an uninformative state of knowledge [1] to derive Gaussian priors for the subsequent iterative retrieval using a theory-based numerical method called OptimalEstimation [2].The estimates are then used to model and substract the thermal emission component from the total measured radiances. The final temperature maps deviate by 1–3 K from the first-step estimates, and Final emissivity uncertainties on the order of 10^{-3}. For Haulani crater, the retrieved temperatures show lower values compared to results from [3].

References

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