AN ATMOSPHERIC CORRECTION ITERATIVE METHOD FOR HIGH SPECTRAL RESOLUTION AEROSPACE IMAGING SPECTROMETERS

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1. INTRODUCTION

The increasing radiometric accuracy and spectral resolution of new aerospace optical imagers devoted to Earth observation is the base for improving the detection of environment characteristics and their monitoring. This option holds true as long as accurate radiometric calibration of the sensor is performed, and atmospheric effects affecting the acquired data are precisely corrected. To this purpose an improved atmospheric correction procedure, which automatically retrieves the main atmospheric parameters, has been developed.

2. DESCRIPTION OF ATMOSPHERIC CORRECTION MODELLING

The availability of data acquired at high spectral resolution allows the detection of different spectral features of many atmospheric constituents. An iterative estimation algorithm based on high resolution data has been developed using the MODTRAN 4 radiative transfer code.

Modeling the radiance propagation, the atmosphere is assumed to be a plane parallel medium [1], [2], [3] whose description requires:

- the absorption and scattering coefficients as a function of altitude ,
- the scattering phase function representing the overall effect of the aerosols and dust particles.

The propagation of electromagnetic radiation through the medium obeys the Radiative Transfer Equation (RTE). Supposing both the atmosphere and the radiation field to be uniform over any horizontal planes, and considering an optically thin the RTE may be solved by using the "successive-order" method [4] in order to retrieve surface reflectance spectra.

For this purpose, a parameterisation of aerosol optical thickness (or visibility), atmospheric water vapour content and other atmospheric constituents like O3 and CO2 is necessary. Such atmospheric data are often missing, while the acquisition parameters on observation geometry are usually known. The autonomous algorithm for retrieving the surface reflectance spectra together with the abundance of some atmospheric constituents is based on the assumption that telluric absorption lines should not be found in the retrieved spectral reflectance.

The default MODTRAN 4 atmospheric profile for the acquired data (date, geographic location) is initially assumed. Then an iterative procedure is started that performs the tuning of H_2O, CO_2, CO, O_3, and aerosol abundances. Tuning of abundances is obtained by several MODTRAN 4 runs, by means of an iterative procedure that ends once the computed values give rise to a spectral reflectance map free from telluric absorption lines, and the simulated ground irradiance matches the available in-field measurements.

To test and validate the method both simulated and acquired at-sensor radiance images have been employed. The acquired images have been collected by the new airborne sensor named HYPER / SIM-GA on the 15th December 2005 during a remote sensing campaign over the Tuscany coast. The sensor covers the 0.4 µm – 2.5 µm spectral range with 768 bands and a bandwidth of 2.4 nm in the Visible Near Infra-Red (VNIR) interval, and 5.4 nm in the Short Wave Infra-Red (SWIR). Preliminary results, showing a good agreement between laboratory and in-field data, are presented and discussed together with the main characteristics of the developed algorithm.

3. REFERENCES

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