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ON THE SLOPE-ASPECT CORRECTION OF MULTISPECTRAL SCANNER DATA

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ABSTRACT IN LIEU OF MANUSCRIPT

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The effects of topography on the radiometric properties of multispectral scanner (MSS) data are examined in the context of the remote sensing of forests in mountainous regions. The two test areas considered for this study are located in the coastal mountains of British Columbia, one at the Anderson River near Boston Bar and the other at Gun Lake near Bralorne. The predominant forest type at the former site is Douglas fir, whereas forest types at the latter site are primarily lodgepole pine and ponderosa pine. Both regions have rugged topography, with elevations ranging from 275 to 1500 metres above sea level at Anderson River and from 670 to 1990 metres above sea level at Gun Lake.

Lambertian and non-Lambertian illumination corrections are formulated, taking into account atmospheric effects as well as topographic variations. Terrain slope and aspect values are determined from a digital elevation model and atmospheric parameters are obtained from a model atmosphere computation for the solar angles and spectral bands of interest. In the Lambertian approximation, if sky irradiance and atmospheric path radiance are neglected, one is left with a cosine correction analogous to the one which has been used extensively to carry out illumination transformations of images of horizontal terrain. However, this extension of the simple cosine correction to the case of sloped terrain is shown to be inadequate, especially for larger angles of incidence.

Attempts are also made to remove the effect of topography by means of semi-empirical functions primarily based on cosines of the incident and reflected illumination angles. In this vein, correlations and linear regressions between topographic parameters (such as elevation, slope, aspect, incidence angle, reflection angle) and MSS radiance values are investigated for the different forest types under consideration at each site.

The analysis encompasses multitemporal Landsat MSS data at a resolution of 50 metres and 11 channel airborne MSS at resolutions of 20 and 50 metres. Slope-aspect correction algorithms for both of these types of data are implemented in software on the image analysis system at the Canada Centre for Remote Sensing. Geometric rectification is also a prerequisite in order to relate image geometry to the map coordinates on which the digital terrain data are based. A special technique involving flight line modelling is used to accomplish this in the case of aircraft data since prior knowledge of the terrain elevation is needed for each image pixel in order to establish an undistorted transformation.

Feature selection based on divergence criteria indicates that terrain parameters compare favourably with the MSS data in terms of ability to distinguish between forest classes. However, maximum likelihood classification results for MSS data, corrected for slope-aspect effects using a variety of functions, show little or no significant improvement over results obtained using uncorrected data. This outcome is discussed with a view to achieving a better understanding of both the physical principles and the image processing methodologies involved.