Accuracy Enhancement of Topographic Mapping Using Multispectral Imagery

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Photogrammetric technology is now at the dawn of a new historical phase of development, as the possibility of real matching-based automation is finally within reach. Matching is a fundamental task performed manually by a human operator with stereovision skills. Automating this human-controlled process has been pursued aggressively for many years. In this dissertation, I present a new approach to matching for automated surface extraction through the utilization of multi-band imagery.

This research is based on the assumption that multispectral imagery has a broader information content than single band imagery. The matching certainty level should be increased as a function of the compounded variances from all those spectral bands included in the matching process. The hypothesis of this dissertation states that matching accuracy obtained using all available spectral bands is higher than that obtained from panchromatic, single-band imagery. The hypothesis further states that image scanning resolution is not the primary factor in surface accuracy.

To test this twofold hypothesis, matching techniques have been investigated through extensive experiments. In addition to the ordinary one-dimensional version of these techniques, multi-dimensional extensions have been developed and documented. Such an extension is not merely adding another spatial dimension and simply extending the integral shift. The contribution in this work is in its conceptual formulation, which is heavily dependent on vector representation of non-continuous observations, i.e., the multispectral intensity vector-value. Furthermore, critical parameters in the matching process, such as window size and sampling interval have been investigated.

It has been demonstrated clearly that the cross-correlation coefficient increases when using multi-dimensional matching on specific land covers, such as vegetation. This increase is consistent and repeatable when compared with the principal component and panchromatic images or with the individual bands. With other land covers, however, there is no accuracy gain by using multi-dimensional matching.

Furthermore, this research has shown only small degradation in accuracy occurs as a result to increasing (coarser) resolution. As a result, this finding agrees with the hypothesis that scanning resolution is not a primary factor in accuracy.