# MAP/IMAGE CONGRUENCY EVALUATION KNOWLEDGE BASED SYSTEM

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## ABSTRACT

A Knowledge Based System (KBS) for analyzing LANDSAT MSS images and comparing this analysis to corresponding geocartographic data is presented. This paper discusses the preprocessing requirements for the LANDSAT and the geocartographic data for a uniform representation of the data. The segmentation of the LANDSAT data and the interpretation of the segments are presented. The preprocessed data are read into the Map/Image Congruency Evaluation (MICE) KBS where the image segments are classified and then compared with the map data, based on class, segment size, shape, and location. Results of the map/image congruency analysis are output and converted to image form. This paper presents the MICE KBS and reviews the results generated for a LANDSAT MSS scene of the Prince George area of British Columbia.

KEYWORDS: LANDSAT, computer cartography, image analysis, artificial intelligence, knowledge based systems

## SUMMARY

Remotely sensed data, particularly from the LANDSAT series of satellites, are being used for a wide variety of useful applications. One of the more challenging applications is the data integration of remote sensing data with existing cartographic data bases. It was found that simple algorithmic data integration methods did not provide satisfactory results due to various geometric irregularities in the remote sensing data and in the cartographic data. These spatial irregularities could be due to factors such as temporal differences between the data, spatial errors in the map data or topographic effects in the remote sensing data. Algorithmic techniques break down in this data integration [BILLINGSLEY82]. Therefore, we have tried to solve the integration problem with a knowledge based system approach.

The Map/Image Congruency Evaluation (MICE) knowledge based system was developed to study the spatial differences between maps and images. Map/-image congruency evaluation means the determination of the spatial agreement of features in the map with the corresponding feature in the image. The data integration problem study included three basic operations. These operations were: (i) preprocessing the data for uniform representation of both the image and the map data; (ii) spatial reasoning on the data using the PROLOG-based MICE system; (iii) output of a congruency evaluation map from the results of the MICE analysis.

The MICE system was evaluated using LANDSAT MSS data for the Prince George area of British Columbia and a BC provincial forest cover map. Various levels from the BC digital map were selected. These levels corresponded to single-line creeks and rivers; double-line rivers and lakes; road and utility systems; and the forest cover. Each level was gridded to a 50x50 metre grid. The LANDSAT data were geocoded by the Canada Centre for Remote Sensing (CCRS) Digital Image Correction System (DICS) to a UTM coordinate grid with 50x50 metre pixels. The sub-area of the image corresponding to the map was selected.

The LANDSAT image was then segmented to highlight the various features. Numerous properties such as the segment shape, size, location and spectral means were evaluated. The map data were similarly processed to determine properties such as shape, size and location. These data were then read into the knowledge based MICE system.

The MICE system then evaluated the matching of the various segments from the map and image by examining the identification of the segments and the structure of the segments. The identification of the segments was done to determine if the structurally corresponding segments have corresponding identifications. For instance, a segment that has been identified as a lake in the map data must correspond to a segment in the image that has a spectral signature that corresponds to a lake. If the LANDSAT segment does not have a corresponding spectral signature, then the segment is only weakly identified. Finally, the exact positions of the remaining segments are determined and all location differences are reported.

The MICE system, which is currently under development, uses a variety of meta-level rules and object-level rules. These rules and some of the internal workings of the knowledge based system will be given, as well as suggested enhancements.

## INTRODUCTION

For many years, human photo-interpretors have been analyzing air-photos, deciding on the classi-