CHANGE DETECTION IN DIGITAL IMAGERY USING THE ADAPTIVE LEARNING NETWORKS

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ABSTRACT
This paper reports research conducted on the problem of change detection in digital imagery. The detection of changes is very important in any applications which require comparison of many images of the same scene. The problem requires an approach which is flexible and can adapt to varying data trends. The system is based on the adaptive learning networks which are an implementation of the N-tuple method of pattern recognition.

Several experiments were carried out to optimize the net parameters and test the performance of the net for this application. A new mapping structure for the N-tuple was devised to cope with insignificant scattered changes that might occurring a scene. Also the size of the minimum detectable object in a scene was also determined.

INTRODUCTION:
The problem of change detection presents itself in the analysis of data from imaging sensors that view the same area repeatedly. It involves comparing two or more images of the same scene to identify the change that has taken place.

An automatic change detection system would relieve the interpreter of a great burden by identifying the change areas and possibly describe the change.

Besides its importance for military surveillance, other applications include urban planning, weather prediction, land resource management, industrial parts recognition and medical image interpretation.

Most of the early work on change detection concentrated on aerial imaging sensors [1,2]. These require highly accurate image registration and extensive corrections for geometric distortions generated by the system and the terrain. Both of these operations are arithmetically intensive.
For determining whether significant changes have occurred, several techniques have been proposed. Simple subtraction of the two images was used, and the difference image was classified [3]. In [4] the Kolmogrov-Smirnov (K-S) test was used to compare two Landsat images of the same area. The K-S test evaluates whether two samples have been drawn from the same population, and hence can detect the presence of change.

In [5] Kawamura discusses a change detection system for use in urban development. He divides the area into small cells, and identifies the change in each cell depending on three parameters; correlation coefficient, entropy and high intensity probability. All the above methods require intensive calculations.

Several methods have been proposed for studying tomographic and nuclear medicine images [6,7]. However, they are optimized for the problem at hand and not general procedures.

It should be noted that all the above methods depend on comparing two images, one as reference and the other for testing. In time varying environments no one image can give a good description of a scene. This is because a number of insignificant changes can occur randomly in the scene which cannot be accounted for. The application of specific rules and algorithms becomes more complex and time consuming. Thus the need for more general adaptive approach became apparent. The response of this approach is evolved from a representative set of the data to be encountered.

In this paper a new technique is proposed. The system can "learn" from multiple coverages of the scene, and then can identify whether a new coverage is significantly different from other coverages. The system is based on the adaptive learning networks (ALNs) which are an implementation of the N-tuple method of pattern recognition [8,9]. No formal definition and correction for the inaccuracies of the imaging system and terrain are required. This is replaced by a training procedure with reference to known examples to the scene to be encountered. Also the ALN digital hardware implementation in the form of memory elements can be readily and cheaply achieved and its inherent parallel structure makes it extremely fast in operation.

This paper investigates the implementation of a change detection system using the ALNs. This novel approach to change detection has shown good discrimination capability even in the presence of distortions and added noise. The size of minimum change which can be detected in various noise levels is determined.