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### Multivariate statistical model for change Detection in images with image classification

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**Abstract**—Satellite remote sensing imagery has been used to track changes on the Earth surface for applications including, plantation monitoring, and urban database updating. To achieve this, different sensors have been investigated including optical, synthetic aperture radars (SAR) or multi-spectral sensors. Optical sensors provide high resolution images due to the involved wavelengths. As a consequence, huge databases of optical images are currently available. On the other hand, SAR images can be acquired even at night or under bad weather conditions and thus are more rapidly available in emergency situations. Since remote sensing images are commonly used to monitor the earth surface evolution, this surveillance can be conducted by detecting changes between images acquired at different times and possibly by different kinds of sensors. A representative case is when an optical image of a given area is available and a new image is acquired in an emergency situation (resulting from a natural disaster for instance) by a radar satellite. In such a case, images with heterogeneous properties have to be compared for change detection.

#### 1.INTRODUCTION

Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional

systems. Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

#### A.Purpose of Image processing

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.

4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre-processing, enhancement and display, information extraction.

## 1.2 IMAGE SEGMENTATION

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is the process of dividing an image into multiple parts. This is typically used to identify objects or other relevant information in digital images. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. Segmentation techniques are either contextual or non-contextual. The latter take no account of spatial relationships between features in an image and group pixels together on the basis of some global attribute, e.g. grey level or color. Contextual techniques additionally exploit these relationships, e.g. group together pixels with similar grey levels and close spatial locations.

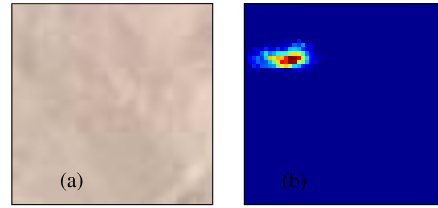


Fig. 4. Images before and after the construction of a road in south of Toulouse and the corresponding joint distribution. (a)  $I_{old}$ . (b)  $I_{new}$ . (c)  $p(I_{old}, I_{new})$ .

## 1.3 SCOPE OF THE PROJECT

In this proposed system is a new statistical model to describe multi-channel images and analyze the joint behavior of the channels to detect changes, in contrast with channel by channel analysis multi-spectral and panchromatic images and new similarity measure showing encouraging results for homogeneous and heterogeneous sensors. The proposed system is interesting for many applications: Change detection, Classification and image segmentation method. This project mainly concentrated on the detection of changes between optical and synthetic aperture radar images. The proposed model could be interesting for many other applications such as image segmentation, image registration, database updating, image indexing or image classification.

## 2.1 RELATED WORK THRESHOLD

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity  $I_{ij}$  is less than some fixed constant  $T$ , or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming completely white.

## CATEGORIZE THRESHOLDING METHODS

### Multi threshold

Color images can also be thresholded. One approach is to designate a separate threshold for each of the RGB components of the image and then combine them with an AND operation. This reflects the way the camera works and how the data is stored in the computer, but it does not correspond to the way that people recognize color. Therefore, the HSL and HSV color models are more often

used; note that since hue is a circular quantity it requires circular thresholding. It is also possible to use the CMYK colour model

### **Probability distributions**

Histogram shape-based methods in particular, but also many other thresholding algorithms, make certain assumptions about the image intensity probability distribution. The most common thresholding methods work on bimodal distributions, but algorithms have also been developed for unimodal distributions, multimodal distributions, and circular distributions.

### **HIGH RESOLUTION**

Image resolution is the detail an image holds. The term applies to raster digital images, film images, and other types of images. Higher resolution means more image detail. Image resolution can be measured in various ways. Basically, resolution quantifies how close lines can be to each other and still be visibly resolved. Resolution units can be tied to physical sizes (e.g. lines per mm, lines per inch), to the overall size of a picture (lines per picture height, also known simply as lines, TV lines, or TVL), or to angular subtense.

Line pairs are often used instead of lines; a line pair comprises a dark line and an adjacent light line. A line is either a dark line or a light line. A resolution of 10 lines per millimeter means 5 dark lines alternating with 5 light lines, or 5 line pairs per millimeter (5 LP/mm). Photographic lens and film resolution are most often quoted in line pairs per millimeter.

### **Pixel resolution**

Resolution is the capability of the sensor to observe or measure the smallest object clearly with distinct boundaries. There is a difference between the resolution and a pixel. A pixel is actually a unit of the digital image. Resolution depends upon the size of the pixel. Usually, with any given lens setting, the smaller the size of the pixel, the higher the resolution will be and the clearer the object in the image will be. Images having smaller pixel sizes might consist of more pixels. The number of pixels correlates to the amount of information within the image.

### **Spatial resolution**

The measure of how closely lines can be resolved in an image is called spatial resolution, and it depends on properties of the

system creating the image, not just the pixel resolution in pixels per inch (ppi). For practical purposes the clarity of the image is decided by its spatial resolution, not the number of pixels in an image. In effect, spatial resolution refers to the number of independent pixel values per unit length.

### **Spectral resolution**

Color images distinguish light of different spectra. Multispectral images resolve even finer differences of spectrum or wavelength than is needed to reproduce color. That is, multispectral images have higher spectral resolution than normal color images. Spectral resolution is the ability to resolve spectral features and bands into their separate components. The spectral resolution required by the analyst or researcher depends upon the application involved. For example, routine analysis for basic sample identification typically requires low/medium resolution.

### **Temporal resolution**

Movie cameras and high-speed cameras can resolve events at different points in time. The time resolution used for movies is usually 24 to 48 frames per second (frames/s), whereas high-speed cameras may resolve 50 to 300 frames/s, or even more.

### **Radiometric Resolution**

Radiometric resolution determines how finely a system can represent or distinguish differences of intensity, and is usually expressed as a number of levels or a number of bits, for example 8 bits or 256 levels that is typical of computer image files. The higher the radiometric resolution, the better subtle differences of intensity or reflectivity can be represented, at least in theory. In practice, the effective radiometric resolution is typically limited by the noise level, rather than by the number of bits of representation.

### **COMPARATIVE STUDY ALGORITHM**

- Fuzzy Local Information C-Means Algorithm (FLICM)
- Entropy-Based fuzzy clustering (EFC)
- Fuzzy Possibilistic C Means Algorithm (FPCM)
- K-Mean Clustering (K-Mean)
- Multiple Kernel Fuzzy C-means Clustering (MKFCM)

### **3.CONCLUSION**

The first part of this paper introduced a new statistical model to describe the

distribution of any number of joint images independently of the kind of sensors used to obtain these images. The proposed model was based on a mixture of multi-dimensional distributions whose parameters can be estimated by the expectation-maximization algorithm. This mixture of distributions can be used to determine standard similarity measures such as the mutual information and is thus interesting for many potential applications. The second part of this article introduced a new change detection strategy based on a test statistics estimated from training images without changes. This strategy was compared to classical methods for synthetic and real data showing encouraging results. This paper mainly concentrated on the detection of changes between optical and synthetic aperture radar images. However, the proposed model could be interesting for many other applications such as image segmentation [61], [62], image registration [34], [63], database updating [64], image indexing or image classification. Moreover, when the dataset consists mostly of unchanged areas, the whole image can be used for the manifold estimation since the influence of the changed areas are negligible. In this case the proposed strategy can be used to build a completely unsupervised change detector. These applications would deserve to be studied in future work.

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