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IMAGE CHANGE DETECTION USING STEREO IMAGERY AND DIGITAL SURFACE MODEL

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***ABSTRACT*— The image change detection is been used in various applications like map updating, building change detection, disaster assessment, military application etc. In recent years image matching algorithm from computer vision have been introduced and used in satellite imagery. One of the important application of image change detection such as building change detection is discuss in this paper. When we are dealing with building change due to different imaging conditions 2D information obtain for different dates is not sufficient. It has been become difficult to distinguish the building changes from various man made construction such as roads and bridges due to similarity. So for to obtain the 3D building changes, stereo imagery is of importance. Therefore Digital Surface Model(DSM) and stereo imagery is used for building change detection. To detect the similarity information between two original images the Kullback Leibler Divergence(KLD) is preferred. Whereas Dempster Shafer Fusion theory (DS fusion) is used to combine the result of DSM and K L divergence , in order to improve accuracy. Image change detection can be used in both rural and urban area, image obtain from digital camera ,satellite, Google earth, USGS etc. Detecting and monitoring urban area changes are of great relevance for city planning, environmental monitoring. In this we have shown a example of image change detection. Change detection by information measure using radio metric information at the level of pixel is not sufficient to discriminate the ground structure. So object based or structural based image description are used to resolve the problem of radio metric information. If resolution of image is decreases than transform produce a non-linear temporal behavior which cannot be capture by linear transform change detection method.**

Keywords—Image change detection, DSM, image matching, Vegetation, DS fusion.

I. INTRODUCTION

The image change detection using stereo imagery and DSM technique uses a two different dates images we can also detect changes from multispectral images. Such a change is detected by using a image processing tool box in a MATLAB. Previously developed change detection method for medium resolution of satellite images are not efficient for high resolution images. When the real land cover changes are mixed with irrelevant changes. To detect a image changes it is necessary to do DSM co-registration to avoid the any shift in two images due to different angle of camera. The effect of shadow and vegetation can be removed by using image refinement [1]. For a two different dates a panchromatic images are obtained because it produces a realistic reproduction of a scene as it appear to the human eye. There are different method to generate a DSM by using a tool like MATLAB, Geomatica etc. Erdas Imagine software can also be used to detect a image change. Before proceeding to DSM first the thresholding is done on a image . Hough transform is used for detection of randomly shapes in a image. Sobel edge detection algorithm is used for detection of a edges in an images. The high resolution remote area image can be obtained by TerraSAR-X, world view and IKONOS satellite[2]. The image from IKONOS satellite is consider in this project. Image change detection can be implemented by based on information measure.

II. WORK FLOW OF THE PROPOSED 3D IMAGE CHANGE DETECTION

The figure 1 shows the workflow of 3D image change detection[4]. As shown in figure initially two different dates images are taken say time t1 and time t2. Secondly DSM is generated using DSM algorithm. After generation of DSM their co-registration is done, by image differencing of co-registration image we obtain a 3D change detection map.If co-registration of DSM generated image is not done in such a situation leads to noise in a change map. Another effect that can cause noise in image change map is a quality of DSM.

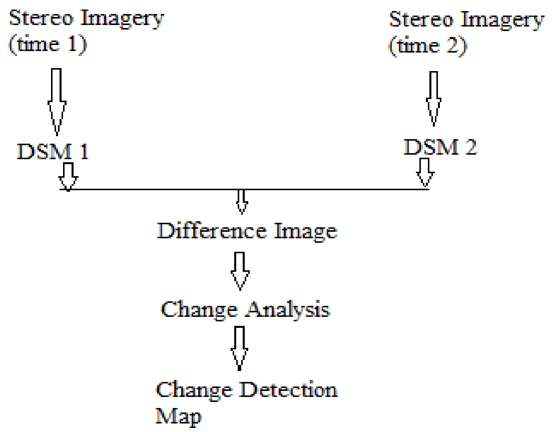


Figure (1) Flow chart for image change detection(building change).

III. IMPLEMENTATION OF IMAGE CHANGE DETECTION

Thresholding of an Image

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 $I_{i,j}$ is less than some fixed constant T (that is, $I_{i,j} < T$), or a white pixel if the image intensity is greater than that constant.

Hough Transform

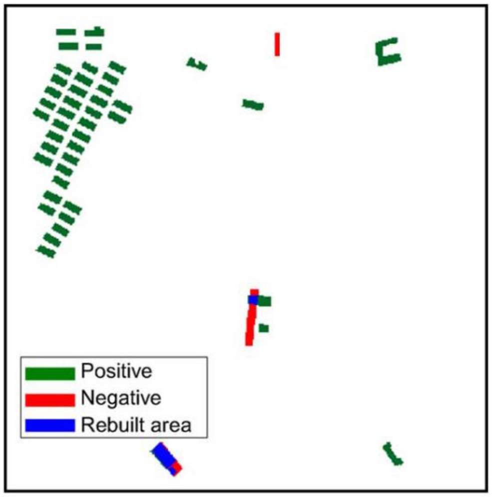
Hough transform is used for pixel linking and curve detection. In a Hough transform a set of discrete pixels, the Hough transform checks if these point lie on a straight line and if yes, it draws a line joining all these points. The classical Hough transform does the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses.

Example of Image change detection

Figure(a) Image from year 2006.

Figure(b) Image from year 2011.

Figure(2) Panchromatic image



Figure(3) Change map of two dates.

IV. Building Change Indicator

Fusion method can be used to indicate building changes from other changes as follow:

Height Change

DSM is generated using a robust stereo matching algorithm based on semi-global matching (SGM) using a combination of census and mutual information as cost functions . After DSMs from two dates are generated, first a co-registration between them is necessary to remove any shift in three dimensions. When same image is capture by different angle by satellite co-registration is required to analyze change detection between two dates same images. Normalized cross correlation can also be used for co-registration of images. Depending on data availability and accuracy, the DSMs can be of similar or quite different quality. If the DSMs have good quality, a pixel-wise subtraction of the two DSMs can already lead to good change results, but for space borne stereo data, such a subtraction is generally not applicable.

A robust difference between the initial DSM $x1$ and the second DSM $x2$ for the pixel (i, j) can be defined as the minimum of differences computed between the pixel $x2(i, j)$ in the second DSM and a certain neighborhood (with window size $2 \times w + 1$) of the pixel $x1(i, j)$ in the first DSM $x1$. The robust positive and negative differences $XPdif\ (i, j)$ and $XNdif\ (i, j)$ relative to the pixel (i, j) are defined as written in (1) and (2),

$$\mathrm{XPdif}(i,j)=\min(p\in[i-w,i+w],q\in[j-w,j+w])\{(x2(i,j)-x1(p,q)),(x2(i,j)-x1(p,q))>0\}. \quad (1)$$

$$\mathrm{XNdif}(i,j) = \max(p\in[i-w,i+w],q\in[j-w,j+w])\ \{(x2(i,j) - x1(p,q)),(x2(i,j)-x1(p,q))<0\}. \quad (2)$$

It means that only the minimum value (greater than zero) in case of positive change, or the maximum value in case of negative change is taken, all within the defined window size.

Similarity Measurement

If at least one of the DSMs exhibits larger errors introduced in the matching procedure or through interpolation, false alarms will still be produced in the height difference map. Therefore, in addition to the robust differencing, a robust change indicator using original satellite images can be very helpful to improve the accuracy. As radiometric information for the same land cover class can be very different due to the different acquisition circumstances. Instead of comparing gray values directly, we use an information similarity measure to highlight building changes. Information similarity measures, such as Mutual Information, have been widely used in the image processing community [2]. One prominent work proposed KL divergence for multi-temporal change detection based on the evolution of the local statistics of the image between two dates. The local statistics are estimated by using 1-D Edgeworth series expansion, which approximates probability density functions (PDFs) in the neighborhood of each pixel in the image. In this method was extended for object-based change detection by computing the KL divergence of the two corresponding objects derived by image segmentation.

No-Building Change Indicator

In binary change detection, a very important final step is to separate the relevant changes associated with buildings from other changes (noise and other areas which might contain irrelevant change, here e.g., no-buildings). Vegetation growth can also create a height change, and if these areas are located around buildings, it will largely influence the building change detection result. To alleviate this effect, we use normalized difference vegetation index to indicate vegetation cover.

Another important effect is shadowing which can significantly influence the quality of the DSMs. It has been shown in our previous paper that shadow areas usually result in relatively bad matching results. Matching failures in shadow areas, which often represent ground level, are displayed in the original generated DSMs partly as holes, and through interpolation methods, they often get higher height values than the ground level. If this kind of error exists only in data of one epoch, building change alarms are produced. Here, the shadow mask is extracted with the method introduced by Marchant and Onyango in which the relationship of red/blue channel and green/blue channel can be used to extract the shadow class. In urban areas with simple building structures, vegetation and shadow areas can be successfully detected in the multispectral data in order to substantially reduce their influence to the results. For urban areas with more complicated building structures, the differentiation can be more difficult as, e.g. vegetation can also be found on the roof of buildings. Therefore, these features are only used to give a proper probability of no building indication, while not an absolute decision.

Region-Based Refinement

After generating the building change mask, it is still required to separate "changed building" from false change alarms. We therefore apply an edge-based building extraction method and improve the output by extracting the undesired objects based on their shape properties. The three most important features to differentiate building areas from other objects are height, area (size), and convexity. Herein, an object level-based refinement is proposed to combine the three change indicators.

Height

For our purpose, height means the average height for each object, in order to get only one vertical change value for each constructed/destructed building defined by a single mask. We average the pixel values in the fusion result of the "difference image" belonging to the same changed object, and define this value as the vertical change of each building. As follows, we exclude all pixels which have "0" value (no height in the changed area), as well as very low values or very high values which can be attributed to potential blunders in one or both of the DSMs, so that these pixels will not be involved in the mean value calculation procedure.

V. RESULTS

The results of the work till date are computed in the following manner:

Part A

Initially we have taken image from the google earth as shown in Figure(4).

Figure(4) Image obtain from google earth.

1. Load the image in Figure(4) to program.
2. Then we compute with the algorithm of sobel edge detection as its output shown in Figure(5).
3. The output of sobel edge detection for rows(Gx) and coloumns(Gy) is shown in Figure(5) separately.
4. The combine output (Gx+GY) is output of sobel edge detection.

Part B

Hough transform is used to detect randomly shapes, like circle, ellipse in a image.

1. Load the image in Figure(4) to program.
2. Then we compute with the algorithm of hough transform as its output shown in Figure (5).

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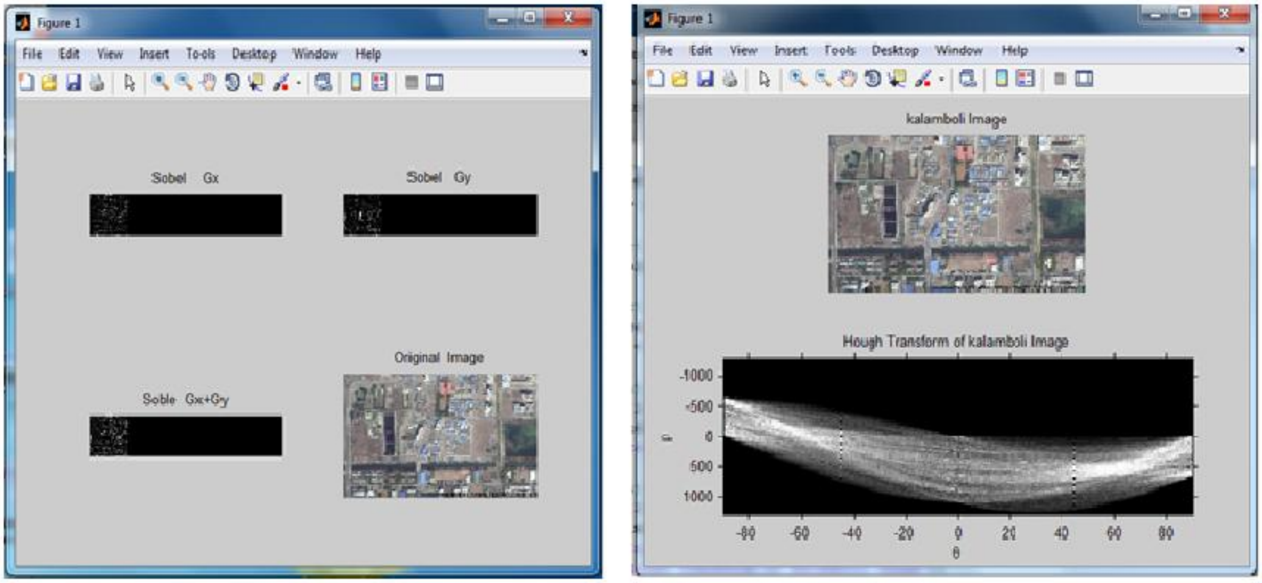

Figure(5) Output of sobel edge detection and Output of hough transform.

CONCLUSION

Image change information is essential for urban area monitoring, and it is particularly helpful for building change detection. In particular, in disaster situations satellite stereo data are usually much easier, faster, and cheaper to acquire. Using new dense stereo matching algorithms and DSM generation technology, that DSMs generated with space borne stereo data can be a reliable source for efficient building change detection. To fully use all of the change information contained in original panchromatic images, multispectral images, and the height information, we use the DS fusion theory for a fusion process to extract real building changes. The generated probability maps can also be used effectively in a semi-automatic procedure

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