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Feature Extraction of Build-up area using Morphological Image Processing

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Abstract

The urban development can be identified by the features likes Road, Buildings, industries etc. fields available in the city. High resolution satellite images provide good data about urban area. This review paper discusses the different ideas for the automatic building feature extraction using the Morphological operators. The images are high resolution images and acquired by the sensors like IKONOS, QuickBird.

Keywords: QuickBird, IKONOS, Morphological operations

1. INTRODUCTION

The high resolution imagery provides open area for automatic detection of urban areas. Which reflect the image of urban development methods available for detecting urban area objects like building, road, trees, agricultural fields etc. These various methods are used for building extraction with help of mathematical morphological extraction method. The Jon Atil Benediktson et.al.(2003) sebastien Lefevre et al.(2007), and Neeti Daryal et.al.(2010) different scientist used the concept of mathematical morphology for urban feature extraction for that purpose they use remotely sense data. The mathematical morphology method is used for quantitative analysis of spatial structures that analyzing shapes and forms of objects. This methodology consists of four steps: 1. Preprocessing 2. Feature Extraction 3. Post processing and 4. Performance & Evaluation [1]. The remote sensors like IKONOS and QuickBird provides high resolution imagery. The resolution sensors for the IKONOS are 1 m Panchromatic (PAN) and 4m Multispectral (MS) imagery. The IKONOS are launched at sept. 1999 and it was the first Commercial sensors which gives the high resolution imagery and spatial resolution [2].

2. METHODOLOGY

The building feature can be extracted from high resolution satellite images takes several steps according different researcher.

The S.K. Jumlesha (2012) extract feature in four steps 1.preprocessing in this step the Otsu's method is used for thresholding after the morphological opening operator. For building extraction set of morphological operators like erosion, dilation, opening and closing etc. are used [1].

Sebastien lefever (2010) put three step for removing building feature these are generating binary image from panchromatic data, i.e called as gray level image binarization. The binary image is generated by fusion of cluster image denoted:

$$C_{i,j}(x) = \max\{C_i(x), C_j(x)\} \quad (1)$$

Then in second step automatic morphological filtering remove building object whose size is lower minimum size in the raw image. Here filtering is done by morphological opening which gives a combination of erosion and dilation.

$$C_{i,j}(x) = \max\{C_i(x), C_j(x)\} \quad (2)$$

Where S is structuring element of morphological opening which is define according to the values of S. If it is low then it is not containing any building else next step is going on. Third step is building detection can be done by using Hit or Miss Transformation (HTM) which consists in a double erosion of image Square or rectangular building of various size of structuring elements E and F by size

$$I \circledast_{k,l} (E,F) = \bigcup_{\substack{k \in K \\ l \in L}} \left(I \ominus E_{\alpha k,\alpha l}\right) \cap \left(I^c \ominus F_{kl}\right) \quad (3)$$

Lastly post processing is necessary to rebuild the shape for detected building and binary union is performed after geodesic reconstruction [2].

Csaba Benedek(2010) introduce robust marked point process model for building detection which divide building image into building segments here considering five parameters c_x and c_y center coordinate e_L e_t side lengths and $\theta \in [-90°, +90°]$ orientation since configuration space is as [3],

$$\Omega = \bigcup_{n=0}^{\infty} \Omega_n, \quad \Omega_n = \{\{u_1, \ldots, u_n\} \in \mathcal{H}^n \quad (4)$$

Neeti Daryal[2010] extract feature by three steps 1.Preprocessing this stage consist two major operation that is gray scale opening and thresholding the gray scale opening done with basic mathematical morphological operator dilation and erosion and then Otsu's algorithm is

applied to threshold for producing binary image. 2. Thinning is mathematical morphological operator used for skeletonization. For thinning Zhang-Suen's algorithm is used. In post processing is done by conversing skeletonized raster image to vector data using Matlab [4].
Xiaoying Jin (2005) perform steps for evaluation 1. Preprocessing in this step atmospheric correction is done by linear stretch apply to enhance image contrast then morphological smoothing is done. The edge-based watershed segmentation is used for this Sobel edge operator utilized. 2. Differential Morphological Profile for image segmentation 3. Building hypothesis and verification using DMP 4. Shadow supported building extraction 4.1 shadow delineation by DMP in this step gray level thresholding. 4.2 shadow- supported building verification and grouping is done by NDVI. 5. Bright building extraction and then 6. Extraction integration is done [5].
Jon Atil Benediktsson(2003) describe methods for feature extraction Aand feature selection best using principal component analysis some another feature extraction techniques also used like discriminant analysis feature extraction (DAFE) and Decision boundary feature matrix (DBFM) and then features selection based on the sorting of the Indexed of the DMP[6].

3 RESULT AND DISCUSSION

Table 1: Result Discussion

Sr. no	Author	Year	Technique	Sensor/ data set	Result %
1	S.K. Jumlesha	2012	Mathematical Morphology	IKONOS	78.61 %
2	Sebastien Lefever	2010	Mathematical Morphology	panchromatic Quickbird VHR	88%
3	Csaba Benedek	2010	Mathematical Morphology	Arial data set by Google Earth	82%
4	Neeti Daryal	2010	Mathematical Morphology	Scan Satellite image	79%
5	Xiaoying Jin	2005	Mathematical Morphology	panchromatic IKONOS	72.7%
6	Jon Altil Benediktsson	2003	Mathematical Morphology	panchromatic IRS-1C, panchromatic IKONOS	76-77% 90%

Table 1 describes the technique used for the particularly used images from the sensors or data set with results.
In this praposed work the following steps are used as:
1. Preprocessing: In this step in input is convert in to binary image shown in Figure 1., then calculating threshold from it gradient mask is calculate which is shown in Figure 2.

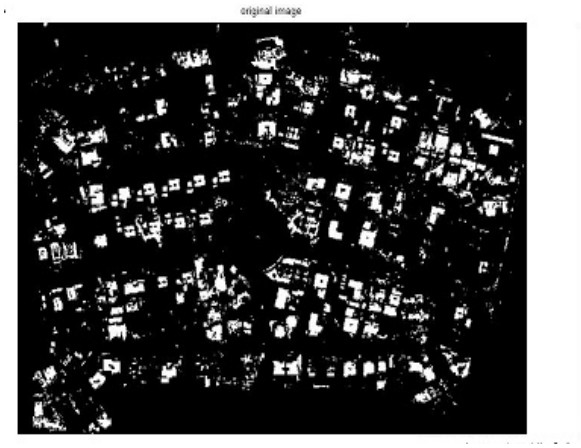

Figure 1 Binary image

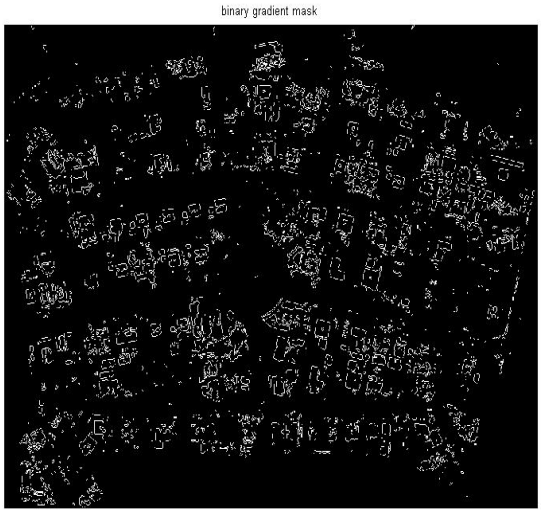

Figure 2 Gradient Mask

Figure 3 Dilated image

After gradient mask dilate operation is perform which give output shown in Figure 3.

Figure 4 Fill hole

Then after fill hole operation is performed and output is shown in Figure 4.

Figure 5 Clear border

Then border clearing operation is performed to get exactly clear object like Figure 5.

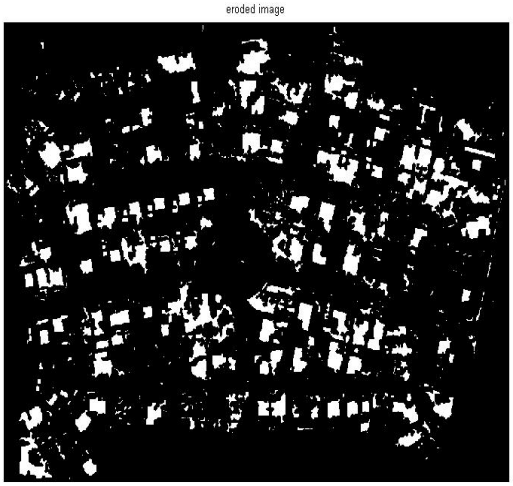

Figure 6 Eroded image

Then after the erosion operation is performed and output is shown in Figure 6.

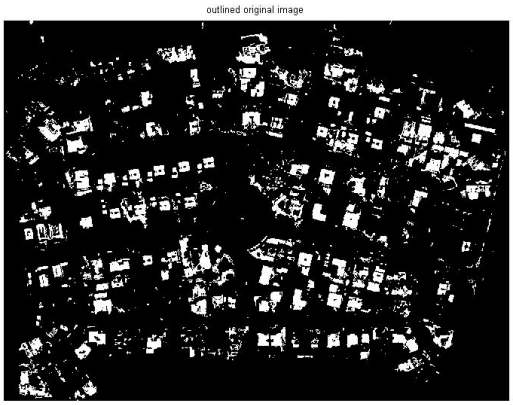

Figure 7 Outline image

At last outline object from the original image is got and it is shown in Figure 7.

In future different operations are carried on image to find the number of object and area of each object.

4.Conclusion

Mathematical Morphology is very useful for the building feature extraction from high resolution imagery like IKONOS and quickbird images. Matlab and Envi software's are used. Generally preprocessing (Ostu's algorithm), Feature extraction (Mathematical Morphology) and Post processing (HTM transformation) steps describe evaluation.

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