AUTOMATIC EXTRACTION OF OBJECTS AND THEIR INTEGRATION INTO AN INFORMATION SYSTEM

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ABSTRACT

In photogrammetric practice, it takes a lot of time to measure continous objects manually. In order to gain time, many objects like roads and buildings can be extracted automatically. To extract these kind of objects, many attempts are done. The aim of this study is to develope a better algorithm for extraction.
The extraction process can be divided into two groups. The first one is to obtain the borders of a geometrically closed object like a building, which can be defined as spatial objects, where the second one is to extract the unclosed objects like roads etc. These two groups seem likely, but there are some differences about the algoritms, which are used to obtain the borders of them.
As application, several images are worked on. The first two examples are images of damaged buildings in Dinar Earthquake (1995) and Marmara Earthquake (1999), in which over 15.000 people were died and thousands of buildings were destroyed.
For documentation and analysis of earthquake damages, an information systems is developed. As basic data, damaged buildings are evaluated photogrammetrically. By these applications, damages on buildings are extracted automatically.
As further application, aerial images and remotely sensed data are worked on. Roads are extracted automatically on aerial images. As a last example, coast line of Marmara Region is extracted from remotely sensed data.

1 INTRODUCTION

In recent years, many approaches and studies are done in order to extract and evaluate of objects form digital images. Aims for these axtractions and evaluations were data acquisation for GIS as well as mapping. As basic data, aerial images and remotely sensed data from multiple resolution and structure were used. In low resolution images, only the road lines vegetation borders etc. can be extracted, whereby in high resolution images some profiles, road borders and buildings.

For automatic road extraction Baumgartner et.al. (1999) has used aerial images from multiple scale and combined all the results in order to obtain a road network. Wiedemann and Hinz (1999) has extracted roads from multispectral satellite imagery. Further applications are made by Heipke and Straub (1999) in order to automatic updating a Geographical Information System using automatic extraction methods from multispectral satellite imagery.

By automatic extraction, lots of approaches and applications can be given. What important is to finding the useful algorithm for the purpose. In this paper, another algorithm for extracting objects from terrestrial and aerial images is discussed and some examples are given.

2 ALGORITHM FOR EXTRACTING GEOMETRICALLY NON-CLOSED OBJECT

In the algorithm, pixel neighbourhoods are numbered as in Figure 1., in which having the same rotation in N, E, W and S. Regarding the problems studied before, it has been exposed that every circle must have the same neighbourhood as the neighbouring two circles. These neighbourhoods are chosen in the basic rotation as N, S, E, W.

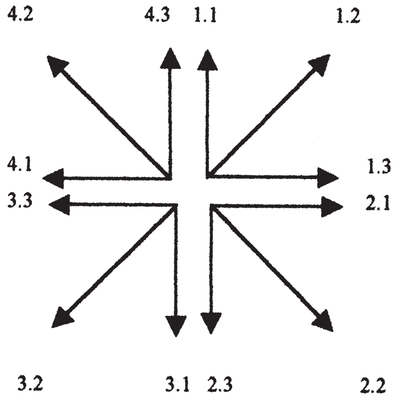


Figure1: Numbers of pixel neighbourhoods in the algorithm (Celikoyan and Altan, 1999)

In Fig.1. the first numbers are referring to the circle number, where the seconds to the neighbourhoods. Aiming matching the borderline of the detail, grey value of the 1.1st neighbourhood has taken from the array, which belongs to the image. If the difference of grey values between standing pixel and the 1.1st neighbour is in the difference border given by the user, this pixel is matched. In the other case the same process is done with the pixel located in the 1.2nd neighbourhood. This process is used until the target pixel is found. If any targeting pixel cannot be found in a circle, the search process goes on with the next circle. Nearby this, if a pixel is found, the next search begins with the 1st neighbour of this circle. An important point is that, if a pixel is found with a 1st. neighbour of any circle, this pixel is marked using the 3rd neighbour of previous circle. In that way, the search process can change its rotation and every borderline from multiple geometry can be extracted. This search process stops until any pixel could be marked using all the neighbours.

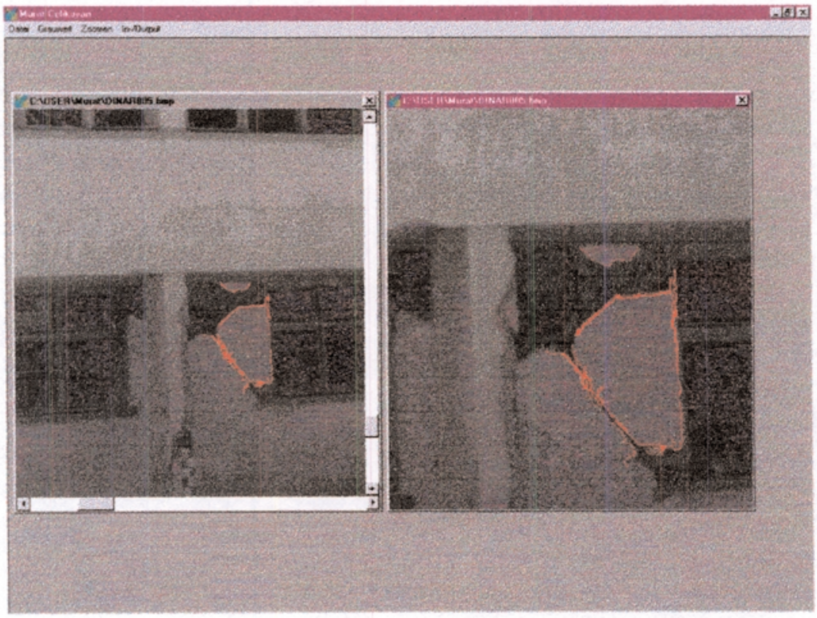
Another point is that the data size after running this algorithm is so large that it slows down the computer process speed. In order to avoid this problem, only break points of the borderline are selected. For this purpose, gradient of this borderline is determined in every point and the points, by which this numerical value has changed, are taken to the data. In that way, the size of the data is minimised approx. from 1 MB to 30-40 KB. (Celikoyan and Altan, 1999)

3 EXTRACTING GEOMETRICALLY CLOSED OBJECTS

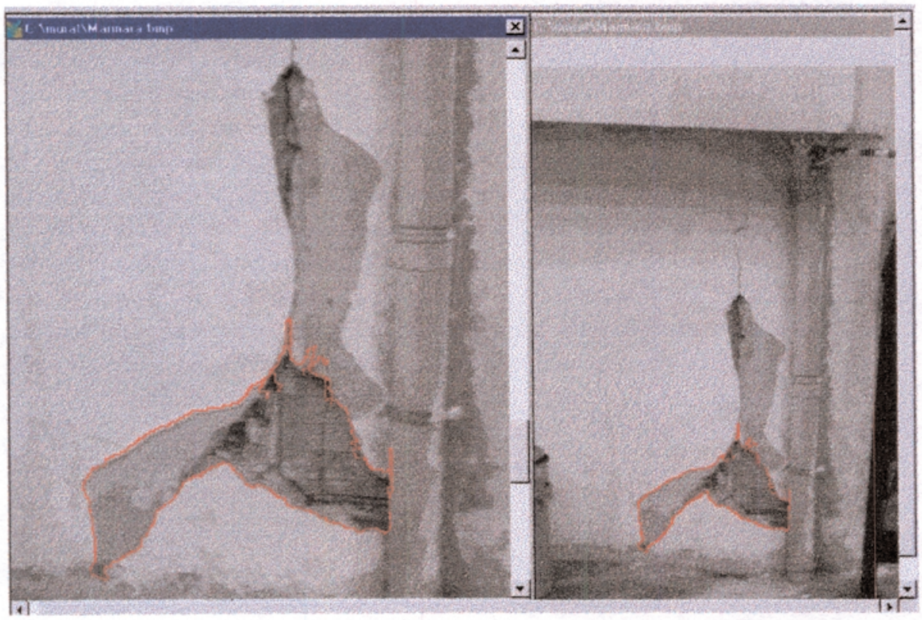
The basic process of extracting geometrically closed objects does not have a big difference from the extracting procedure of non-closed objects. The algorithm, mentioned in Caption 2 is adapted so that it stops, when a previously marked pixel is reached for one more time. In that way, geometrically closed objects are extracted. The handicap by this process is to check the whole image coordinates of previously marked pixel by every search process. This difficulty slows down the process proportionally to the running time. The big amount of pixels marked before, the slower running speed of the algorithm. To avoid this problem partially, the object type, which will be extracted, is given by the user before the search process. In that way, extraction process of non-closed objects does not slow down.

4 APPLICATIONS

As first application, damaged buildings by Dinar (1995) and Marmara (1999) Earthquakes are given. Results of these applications can be used in Geographical Information System developed for modelling and damage analysis of buildings. The images are taken by using Kodak DCS 200 digital camera (1524 x 1012). As it seen in Figure 2, cracks on the damaged building have different grey values from the undamaged part. Using this difference, damages can be extracted from digital images.



a) Dinar Earthquake (1995)



b) Marmara Earthquake (1999)

Figure 2. Damaged building by a) Dinar (1995), b) Marmara Earthquake and extraction of cracks

These are examples for terrestrial images. Further application is done using remotely sensed data and aerial images in order to show that the algorithm fits the conditions both in terrestrial and aerial imagery. On the aerial image, road borders are extracted and on the satellite image coast line is detected automatically.

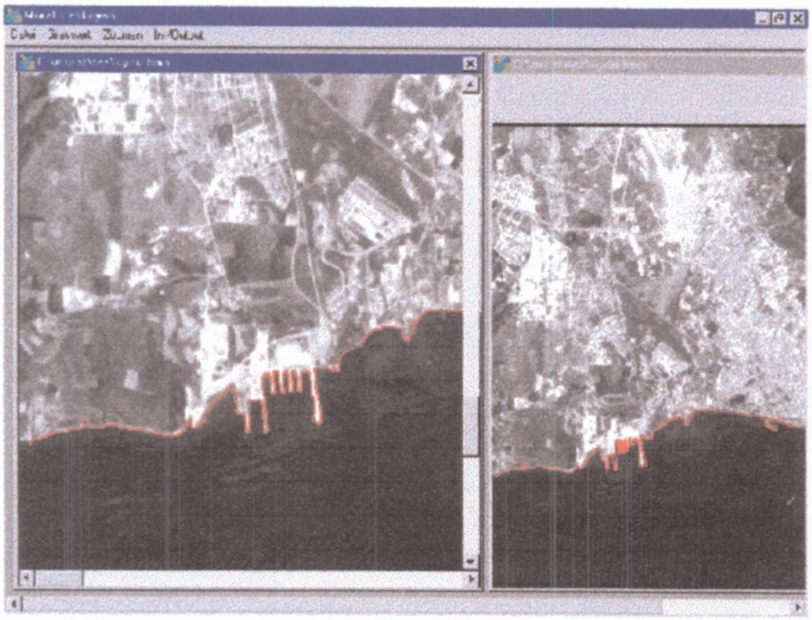


Figure 3. Automatic Extraction of coastal edge from satellite image

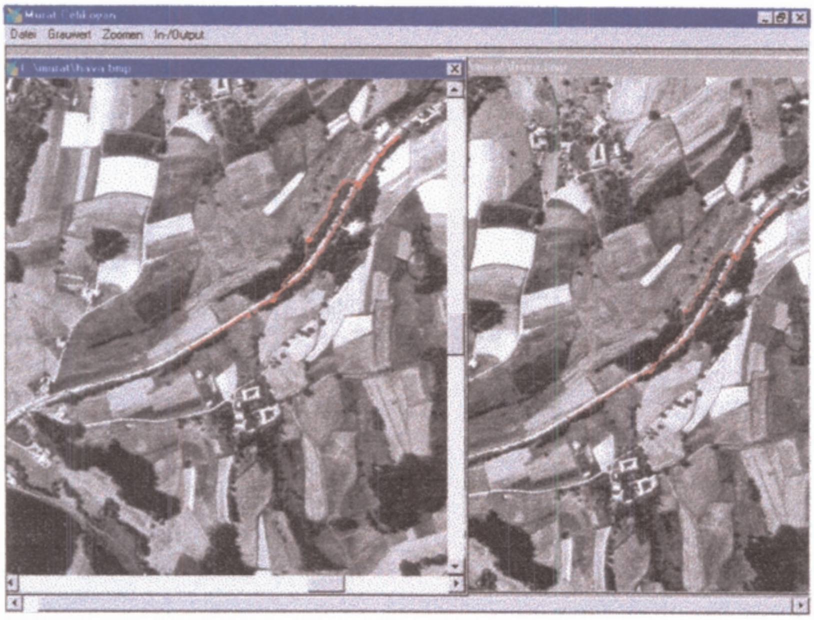


Figure 4. Automatic extraction of road from aerial image

5 DISCUSSIONS AND RESULTS

As it seen in applications, the algorithm reaches its aim. But there are already some difficulties. When high-resolution images are used, the borders seem like stairs according to the pixel size. Nearby this, in Figure 4, related with the trees covering the dealing road from over, some splashings of the extracting line is discussed. These unwilling results can be overcome by using artificial intelligence.

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