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Cartographic Elements Extraction using High Resolution Remote Sensing Imagery and XML Modeling

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Abstract

At the present time, the remote sensing community will have to deal with new data type; very high spatial resolution and IKONOS and Quickbird data give an excellent reference of them. For some topics that are directly implied like environment or urban areas analysis, this new data will be very important. Indeed, the arrival of these images enables a new capability and the study of a range of non-observable objects until now. Using high resolution imagery should make it possible to detect man made features such as buildings, rivers or roads in an easier way than conventional data.

This research presents and proposes an automatic system of cartographic elements extraction from space images, using very high spatial resolution images. This system can be adapted to others types of remote sensing images.

This research work is focus on the extraction of four types of cartographic elements: water areas, urban areas, wooded areas and linear features such as roads or railways. Each type of cartographic element is extracted detecting its own characteristics, using image analysis, applying a segmentation process and knowledge extraction.

To accomplish this task, two approaches must be taken into account; i) an image processing method has to be applied in order to segment the image and; ii) the extraction using a XML modeling in order to extract the different cartographic elements.

Image processing is considered, with the recent arrival of 1m resolution images, an important step that provides a first isolation of the cartographic elements. At this point we use a morphological segmentation process.

This segmentation process is a non linear and auto-adaptative method based on a description of satellite images using an adjacency graph, represented by the Voronoi diagrams, and the application of morphological operator sequences in order to obtain suitable and essential characteristics of each cartographic element in the image. Using this approach, we simplify and conserve the principal features of elements. In the figure 1 and 2, we show an example of the results of this process. All elements are then extracted and stored in a database and with XML tags in order to elaborate meanly queries.

The second approach is the extraction using XML. All characteristics, issue from the segmentation process, are then translated into XML tags. Indeed, this information is then available with a minimum number of operations. The aim of this eliciting process is to

enable post-processing upon the images without referring to the image itself. So we can query these XML tags to extract the desired cartographic elements. Figure 3, shows an example of the tags. In this way, this independence is a great advantage.



Figure 1. Original High resolution image

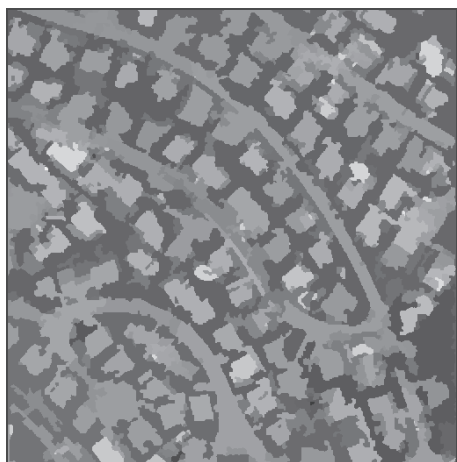


Figure 2. Segmented image

The system stores XML data in its repository, and supports XPath/XQuery query language, that can be more efficient than multi-table SQL joins with unknown (i.e. null relational) values.

Using these two approaches we can then extract the different cartographic elements (water areas, urban areas, wooded areas and linear features) in a structured and simple way.

The contribution of this work includes (1) the use of a segmentation approach based on morphological operations in order to obtain an elaborate knowledge of high resolution images, (2) the use of XML tags to query and extract the desired cartographic elements and (3) the organization of the segmented data to integrate it toward geographical information systems.

```

<?xml version="1.0" encoding="UTF81.0" standalone = "yes"?>
<image>
  <object number = "0" >
    <rad_value> 75 </ rad_value > <area> 637 </area>
    <perimeter-ext> 231 </perimeter-ext>
    <perimeter-int> 224 </perimeter-int>
    <perimeter> 227 </perimeter>
    <card_opening> 637 </card_opening>
    <card_closing> 638 </card_closing>
    <neighbor number = "8" >
      <topology> inside </topology>
    <angle>330.90</angle><distance>114 </distance>
    <leng_contact> 231 </leng_contact>
  </neighbor>
  <mbr>
    <xmin> 63 </xmin> <xmax> 119 </xmax>
    <ymin> 131 </ymin> <ymax> 160 </ymax>
    <xcenter>91</xcenter><ycenter>146 </ycenter>
  </mbr>
</object>
<object number = "8" >
  :
</object>
</image>

```

Figure 3. XML tags

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