A SEGMENTER OF REMOTE SENSING IMAGES FOR DATABASE SPACE POSTGRESQL/POSTGIS

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This article presents a proposal for an operator segmenter of images in the database space with PostgreSQL PostGIS spatial layer and the environment WKTraster. The PGRASTER (Keitt, LIN, 2009), Oracle Spatial GeoRaster (ORACLE, 2009), WKTRASTER (Racine, 2008) PostGIS IN ACTION (OBE, HSU, 2009) are all examples of work that is being developed with the goal of integrating data RASTER in PostGIS/PostgreSQL, which will, among its other features, make an independent analysis of data representation in vector or raster (Racine, 2008). In this sense, and in an attempt to collaborate with the development of the work, an essential question arises at this point: How can one identify, locate and position targets from remote sensing imagery to feed a database which is one of the functions offered by location-based services and internet computer guides? To try to solve this problem, we are working on the development of a segmenter with directional remote sensing images.

The technique used was morphological transformation to segment the image, called a *watershed,* proposed by Soille (1999), which is a combination of targeting growth regions and edge detection. As a result, we are contributing to the integration of remote sensing images in the database object-relational PostgreSQL/PostGis, and introducing a new operational type (raster/vector > vector), complementing other transactions between the geometries proposed earlier (vector/vector > vector), (vector/raster > raster), (vector/raster > vector) and (raster/raster > raster).

This method includes the installation of a development environment as shown below in **Figure 1** and the development of the algorithm for segmenting directional interfaces, using the native programming language PYTHON and SQL statements that are environmentally friendly Postgre/PostGIS.

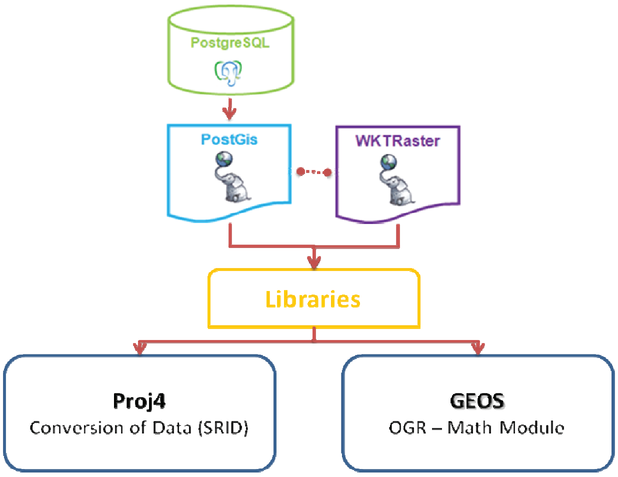

Figure 1 - Development environment.

The development environment consists of the database PostgreSQL, PostGIS module space, the libraries in versions GEOS 3.2SVN and PROJ.4.6.1 and the environment WKTRASTER. The interconnection is made using the library *"rtpostgis.dll."* Next, we use the function *"gdal2wktraster.py"* which reads a raster image of formats GEOTIF, JPG and PNG and converts the SQL file and determines the image's attributes, *e.g*., number of bands, number of pixels, vertical and horizontal pixel precision and divides the images in block sizes that can optimize the file size in SQL. The segmenter directional algorithm was developed using the native language of SQL programming.

The technique employed was the morphological transformation called *"watershed"*, proposed by Soille, (1999), which is a combination of two approaches: targeting growth regions and detection of limits with the following attributes: i) freedom to choose the size of the targets selected; ii) windowing; iii) definition of gray tone, iv) possessing output files with these characteristics: polygons are geo-referenced, and the midpoint of each polygon (lat_{Pc}, long $_{Pc}$), is given; v) this technique is used to estimate the shortest distance, as shown in the diagram in **Figure 2**, with the characteristics described below:

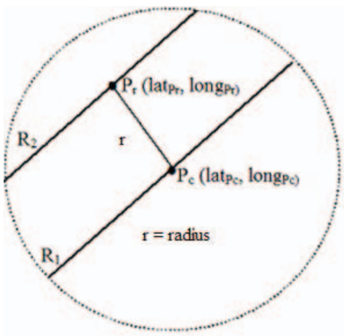

Figure 2 – Schematic diagram of the minimum distance estimator.

∀ reference points (P_r) of the vector map (lat_{Pr}, $long_{Pr}$) in relation to central point (Pc) in each poligon (lat_{Pc}, $long_{Pc}$) being **≤ r**, they are free parameters.

Reference points (P_r) vector map (lat_{Pr}, $long_{Pr}$) ∈ straight (R_2) which is orthogonal to line (R_1) that ⊂ point (Pc) (lat_{Pc}, $long_{Pc}$) in the direction East → West;

The distance between these points (P_r) e (P_c) is minimal,

$$d_{min} \leq \sqrt{(lat_{Pr} - lat_{Pc})^2 + (long_{Pr} - long_{Pc})^2}$$

With landmark (P_r) the vector map and its attributes, P_r (lat_{Pr}, $long_{Pr}$, $altimetry_{Pr}$ and $direction_{Pr}$), determine whether the target is right or left of the landmark:

$lat_{Pr} - lat_{Pc} > 0$; then it is to the left; (1)

$long_{Pr} - long_{Pc} < 0$; so it is to the right; (2)

Considering that both points are located in the same region and in the same hemisphere. In implementing the methodology, the segmenter first reads the image and then apples the segmentation algorithm where the values of the center point and reference point are defined in the central part of each pixel. These values are used in calculating the minimum distance for determining the direction of certain objects in the image, as shown in the diagram of **Figure 3**.

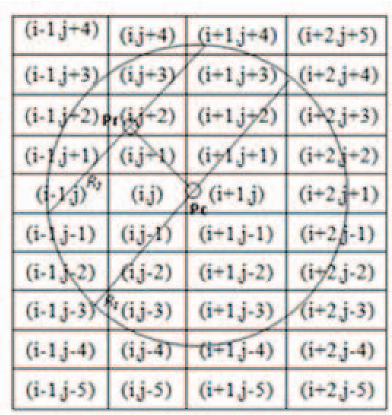

Figure 3 - Scheme of the algorithm to determine the direction of objects in the image.

P_c (i,j) = Midpoint;

P_r (i,j+2) = Reference point;

Minimum distance P_c e P_r =

$$\sqrt{[(((i+1)-(i))/2)-(((i)-(i-1))/2)]^2, [(((j)+(j+1))/2)-(((j+2)-(j+1))/2)]^2}$$

The values of the pixels selected for the segment to be constructed are determined with the conditions (1) and (2) values given in the conditions previously set forth. Then the operator scans targets that are within the area of intersection of the raster with the geometry defined by the polygon to determine the preferred direction according to the angle, as shown in Figure 4.

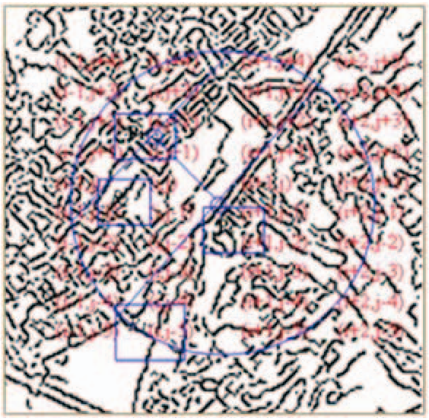

Figure 4 - The intersection of the raster with the geometry defined by the polygon.

Figure 5 shows the results of the intersection that generates the preferred direction of a target relative to benchmarks.

IMAGE		
BAND	COVER	RASTER
1	A	010001110010
2	B	111001001000
3	C	010001111100

∩

MULTIGEOMETRY		
GEOMETRY	DIRECTION	TITLE
Polygon 1	Angle 1	R1
Polygon 2	Angle 2	R2
Polygon 3	Angle 3	R3

=

INTERSECTION			
BAND	DIRECTION	COVER	RASTER
Polygon 1	Angle 1	a	010001110010
Polygon 2	Angle 2	b	111001001000
Polygon 3	Angle 3	c	010001111100

Figure 5 - Result of the operation of intersection: targets and their preferred directions.

Conclusion

This operator has a good performance for calculating an image of 512x512 pixels; its operating time was 53 minutes. The results presented here demonstrate the feasibility of the use of the segmenter of remote sensing imagery for spatial database POSTGRE-SQL/POSTGIS.

References

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