TIN Generation from Digitized Contour Lines

by

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Abstract

This paper desribes one of the possibilities of generating TIN from digitized contour lines. A concept of Borgefors distance transform is utilised to construct thiessen polygons. The topology of the centroid point of the polygons, the neighbouring points is established. The connection of these points eventually formed a series of irregular triangles(i.e. TIN).

1.0 INTRODUCTION

Triangular Irregular Network(TIN) can be generated in several ways. Most of the technique are based on the geometry of the thiessen polygons. Traditionally, the triangles were generated in vector rather than in raster domain. In this study, the latter domain is looked into and experimented. In order to construct the thiessen polygons, searching the neighbouring points, finding the equidistances and the intersection points of the perpendicular bisector of two points have to be solved prior to the triangles generation. All of these aspects can be solved relatively simple in the raster domain. Here, the concept of Borgefors distance transform is utilised to construct the polygons(see Gorte and Koolhoven[1990]). The distance transform is basically a method of calculating the distance from every non-object element in a two-valued raster data sets to the nearest object elements, and the method is a two-pass, recursive, and non-linear operator.

2.0 METHOD

The input of the program is a set of digitized contour lines in an array of X, · coordinates. These points are then rasterized using an ILWIS point-to-raster procedure called PNTRAS module which eventually generates two image files, called .MPD, and .MPI files(see ILWIS Manual[1990]). Half of the smallest gap/distance between the two points is used for the pixel size. To proceed, the background image is assigned as 255 pixel value(in reality, the value may be greater than 255). The raster points are then further manipulated utilising the distance transform procedure. To enhance the result, we introduced horizontal and vertical scans to the image. The following diagram illustrates the brief work flow.

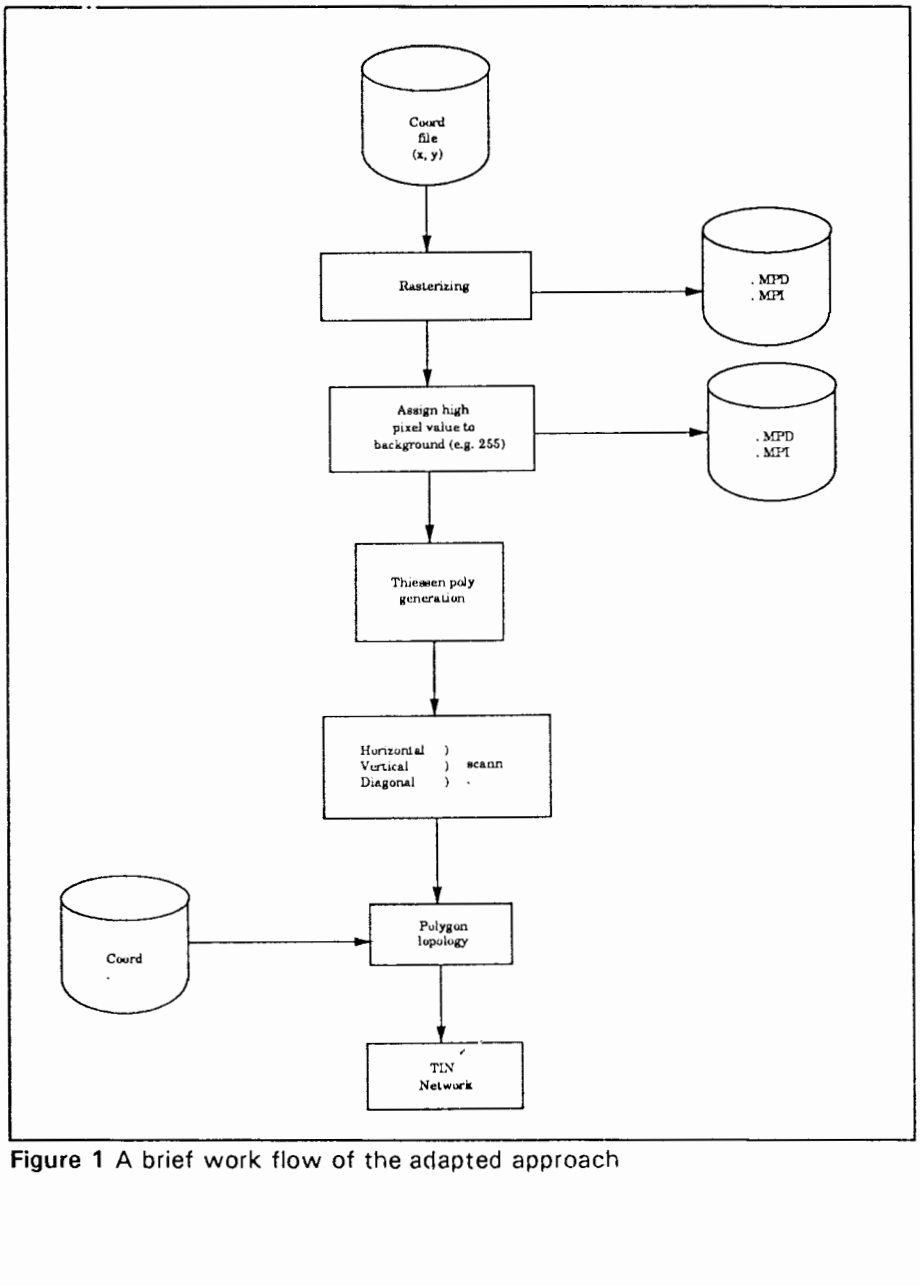

Figure 1 A brief work flow of the adapted approach

3.0 RESULTS

As a result, thiessen polygons are generated for each rasterized points. The polygonization process establishes the topology, thus each point(the centroid) in the polygon has its neighbours. The neighbour relationship(i.e. triangle data structure) is then used to establish the triangles by connecting the appropriate centroid points. It shows that the method works quite well. The thiessen polygons are well generated, the boundaries are well delineated from each other. The dual product of the polygons i.e. the TIN are also well generated. The generated TIN file then converted to the Arc/Info line format(i.e. a file with .LIN format), thus the triangles can be plotted in the Arc/Info environment(see Appendix A to visualise the results).

4.0 CONCLUSSION

To summarise, the experiment shows the possibility of creating TIN in raster domain. Its also indicates the simplicity of generating the triangles compared to the others in vector domain e.g. Radial Sweep algorithm(Mirante and Weingarten[1982]), and Inward Spiral algorithm(McKenna[1987]). Generating TIN in vector domain suffers several drawbacks e.g. neighbouring points searching procedure often complicated and inefficient as commented by McCullagh and Ross[1980]. This problem can be solved relatively easy in raster domain. To improve, the authors suggested that the whole procedure should be able to accommodate the breaklines(one of the important features in DTM), and minimising the computation time for the topology construction. Generally, raster approach offers some advantages e.g. in terms of computation time, neighbouring point searching, and data structuring can be performed quite fast. But, the major drawback is that the rasterizing of the vector data may leads to a situation where loose some of the informations.

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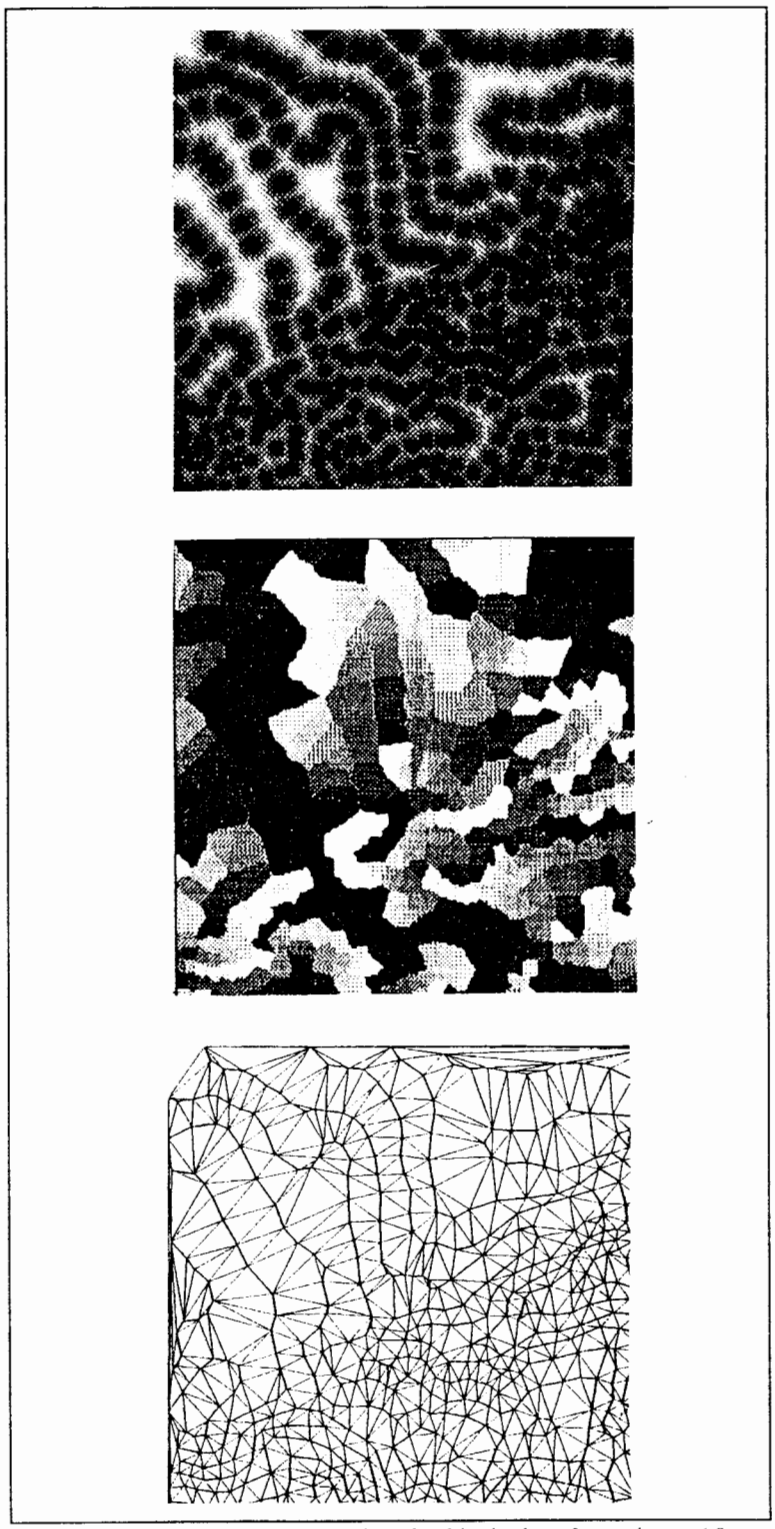

Appendix A Top: rasterized digitized points(from contours); Middle: the corresponding Thiessen polygons of the digitized points; Bottom: the generated TIN