Drawing of Concentric Zone Border Line using Landsat TM Images

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Abstract: Burgessís concentric zone model is a famous theory in the geography of city. However, the zone border line drawing method was uncertain. We have developed the method of drawing the border using land use images.

Keywords: Burgess's concentric zone model, Thunen's bid-rent model, Zone border line

1. Introduction

Burgess's concentric zone model is a famous theory of urban land use. However, the zone border line drawing method was uncertain. We have developed a method of drawing the border line using land use images referred to Thunen's bid-rent model of Fig.1.

In the Thunen's bid-rent model, there are two notable characteristics for zone border line drawing method.

(1) There is a common center position between two land use facilities.

(2) There is a distance characteristic, and a direction characteristic for land use facilities.

Therefore, drawing method is divided into two parts. One is calculation of the center position, and another one is calculation of a distribution characteristic value. In these calculations, we assumed that the number of pixels of Landsat TM images showed the number of facilities of the land use.

2. Land use images

The land use image was made by the Landsat TM images that taken on 16 July 1985. The land use images, urban and paddy images were obtained using an automatic category assignment[1]. The TM images are clustered by unsupervised classification. Each cluster assigned a category so that overall classification accuracy becomes maximum value referring to actual vegetation map edited by Japan Environmental Agency. In result of the assignment, urban and paddy land use images are obtained.

3. Drawing Method

Drawing method of the border line is shown in Fig.2.

1) Create subset images

Urban and paddy land use subset images are created by square shape included target government area. Each image pixel size is Xp. To rotate the images, about 10% areas of the image's edge are filled data of 0.

2) Calculation of center position

Center positions for urban and paddy subset images are calculated. The center positions are defined as xg and yg.
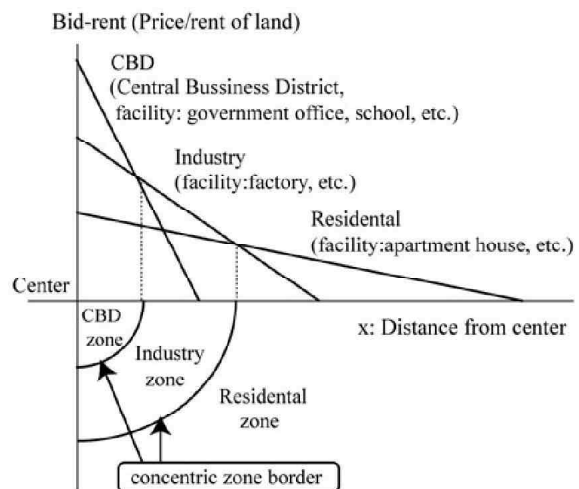

Fig.1 Land use pattern by bid-rent model

To make average distance of these center position's differences from original images are two pixels or less, the subset image's pixel and line sizes have been reduced. The reduced image size is defined as xp. Here xp=Xp/m, m is 4 or 5.

3) Calculation of land use facilities feature value

Land use facilities feature value in distance x from a center position to the right side is calculated. We defined the value xr of the land use feature as the difference of the amount in two facilities as shown in Fig.2. The total pixelís number of urban and paddy in certain x is defined as y1and y2, respectively. The value xr is calculated by the expression (1) and (2) as shown in Fig.2. The xr is defined as the concentric border radius distance from center position.

4) Rotate images

To calculate the xr for any direction, two images were rotated from 0 to 350 degrees at intervals of 10 degrees.
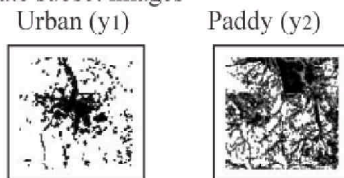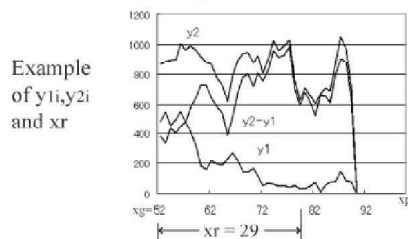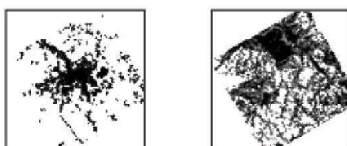

Fig.2 Drawing method of concentric zone border line using land use images

4. Example of Concentric Zone

Fig.3 shows example of concentric zone border line in ichinoseki City, Iwate Pref. Black pixels and gray pixels show urban area and paddy area, respectively. Average of center position is presented by cross mark. The long distance border from center position means that urban zone is more than paddy zone in the direction.

5. Conclusions

We developed a method of drawing the concentric zone border line using Burgess's model and Thunen's model. The border line represented spatial features of the city. Consideration concerning the improvement of the method is as follows.

1) Consideration for geographical features

2) Consideration for actual facilities size

References

[1]Sato, K. and Y. Iikura, R. Yokoyama,1999.Automatic Category Assignment of Satellite Images Using Vegetation Map, *J. of Remote Sensing Society of Japan*,Vol.19 No.4:40-48.
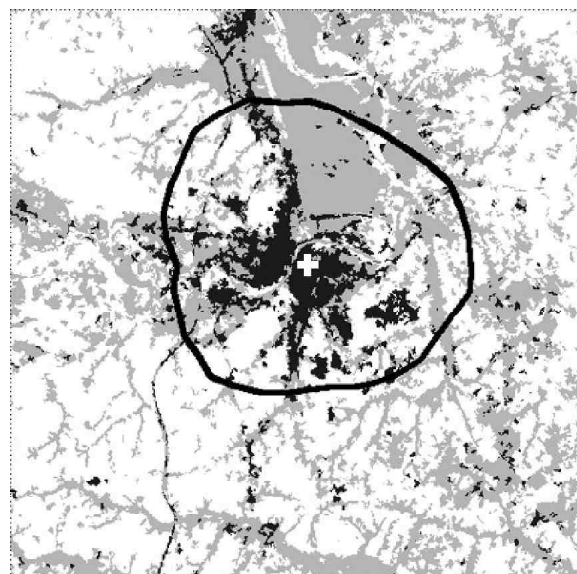
Fig.3 Urban and paddy concentric zone border line in Ichinoseki city