Constructing a New Traffic System in Mountainous Region

Ken-ichi FURUTA[*1]

Abstract

This paper focuses on constructing a new traffic system in mountainous region of Hofu City in Yamaguchi, Japan. The share of the elderly is in the increasing trend by the declining birthrate and a growing proportion of elderly people progress in the region now. Transportation disadvantaged people are expected to be going to increase in the future, and the activation of public traffic becomes important as measures. When measures are planned, local information is needed. The data linked with geographic information can be obtained by using the mesh data. That analyzes it by using the mesh data in a region advanced by declining birthrate and a growing proportion of elderly people in the present study. It is considered the relations between the data distribution and the operation route, etc. of the public traffic problem.

Key Words : mesh analysis, transportation disadvantaged people, DRT(Demand Responsive Transport), mountainous region, public transport

1. Introduction

A lot of routes of the shuttle bus of the public traffic are in the state of the deficit, and most of those costs are covered by the grant from the government etc. A bus user decrease originates the fact that the private car use rate has risen compared with old times, and the demand for the shuttle bus decreases actually in a lot of regions every year[1]. However, the shuttle bus is the important for the transportation disadvantaged people such as senior citizens and children who cannot use the private car. Such transportation disadvantaged people' ratios are guessed in increase, and the shuttle bus cannot be abolished easily. This paper aims at constructing a new traffic system in mountainous region by using mesh data linked with geographic information.

2. Data

The mesh data can display the statistical data by the census etc. on the map as meshes of a net. The advantage of this data is to overlap the statistical data directly on the map. As a result, the statistical data can be understood in parallel with the geographic information. In the aspect from an administrative side, it is convenient to get a clear proof of the priority level in the region where measures should be done from statistics.

3. Methodology

3.1 Geographic information analysis

To analyze the shuttle bus situation of Hofu City together with geographic information, the mesh data used this time are

- Population total
- Total of juvenile
- Total of 65 years old or more.
- Total of employed
- Total of house attendant
- House information.

The mesh data can read the distance and the situation etc. of the surrounding area because of the data displayed on the map. Moreover, the numerical value becomes the standard of comparative study. As a result, it is assumed that the procedure of the analysis is made a pattern, and streamlining and the simplification are attempted.

*1 Department of Civil Engineering and Architecture

3.2 Surrounding mesh mean value of bus stop

There is close relations in the distance of the inhabited area and the bus stop. Then, the convenience of the bus stop is estimated roughly from the mesh numerical value in the bus stop surroundings. The numerical value of the mesh within 250m in radius from the bus stop is first totaled. The population distribution in the bus stop surroundings is counted by averaging by the number of meshes that total this.

3.3 Relation between mesh and route length (accurate method)

If the route of shuttle bus is going the region where a lot of population exists, the demand of the route is high. Then, the numerical value that becomes the standard of comparative study is obtained from the mesh numerical value and the route length of the analysis part. First of all, the value in which propriety to the population distribution in the route can be read by reading, recording the mesh numerical value in the operation direction, and divided the numerical value in the route length.

3.4 Mean value of mesh that route passes (brief method)

When it is necessary to read the numerical value of the accurate method introduced above to obtain the numerical value that becomes a comparison standard is to count the value in the mesh individually, and a lot of routes are analyzed, the efficiency side is bad. Then, a brief method of the analysis is set. This brief method obtains the numerical value that becomes a comparison standard by counting the mesh in the direction according to the class, and using expression (1) from the numerical value of each number and the grade.

$$X=\Sigma\{a(i)\cdot nr(i)\}/n \quad (1)$$

The mean value and a(i) by which X of expression (1) becomes an analysis criterion are mean value of the class, nr(i) is numbers of each classes, and n is total numbers of meshes.

This method has the advantage such as being possible to analyze it even if there is no numerical value of the route length etc. It analyzes it by using this method in three above-mentioned in the present study according to various places.

4. Results

4.1 Whole area of Hofu City

The city conclusion type routes of shuttle bus is Fig.1, and mapped mesh data is Fig.2. The urban function and the citizens gather from this in the surrounding of the station. However, a lot of people reside besides the urban area around Hofu Station and mountainous regions such as Tonomi, Daido, and northern parts of the city, and measures in a shuttle bus and other alternative traffic are necessary for transportation disadvantaged people who live in these regions. It needs the analysis of regional that uses the geographic information and the statistical data about convenience or more for efficient traffic system establishment.

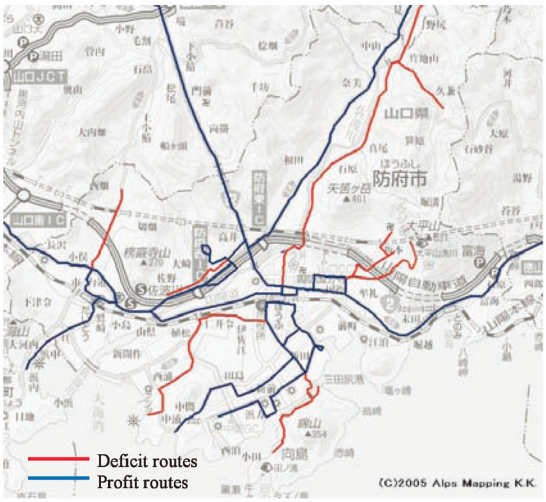

Fig.1 Shuttle bus operation route of Hofu City

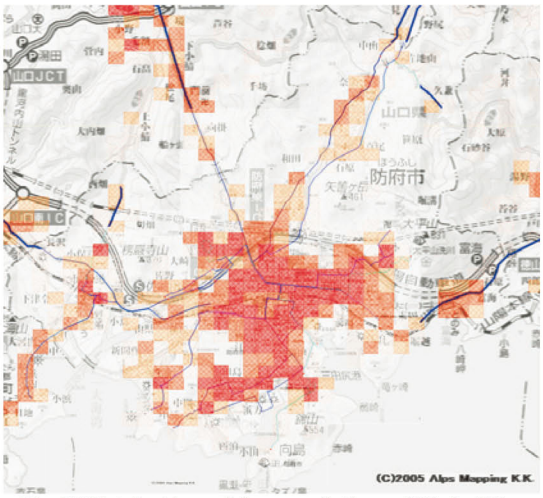

Fig.2 Distribution of the population of Hofu City

Table 1 Mesh class range

Class	Class range	Number of meshes
R1	0～100	615
R2	100～200	256
R3	200～600	269
R4	600～1200	118
R5	1200～	39

The class division was done by five stages of Table1. The numerical value of the class range is population total in a 500m×500m mesh. Because the number is also little the data integrates and calculates class 5 with class 4. Therefore, the expression becomes

X=(50*nr(1)+150*nr(2)+400*nr(3)+900*nr(4))/n

As for Table2, the Passenger Density is an average number of persons of each route, and the number of meshes is the count of the mesh that the route passes. It can be said there is no problem for the route arrangement because the mean value X shows demand in the route when mean value X calculated from this expression is high. Therefore, it is guessed that fewer passenger density routs can select the timetable diamond revision as an improvement idea. Demand in the route is guessed to be lower than another when the mean value X and the passenger density are low, then the improvement idea includes the reduction of the route scale or the use of alternative traffic. The current state of the route can be guessed like this by comparing the mean value X with the passenger density of each route.

Table 2 Passenger density and mean value X

Area	Rout / Terminal		Passenger Density	Number of meshes R1	R2	R3	R4,5	Mean value X
East	RopewayMountainFoot		1.4	1	2	1	9	681
East	Kamikibe		1.3	0	1	1	9	786
East	Shinnagao	Amidaji	1.9	0	1	1	10	796
North	Kamimanao	Hisakane	1.4	17	7	2	5	232
Southwest	Horiguchi	Nakanoura	2.8	1	2	5	15	689
Southwest	City office	Nakanoura	3.2	1	2	5	13	669
Southwest	Oda Port		1.1	8	2	1	5	350
Southwest	Industrial estate Tokai Carbon		2.7	5	1	6	6	456
Southwest	Ishigakuti	Kogaya	3.1	4	4	7	5	405
Northwest	Health center	Ochiai	2.0	1	5	5	5	456
West	Daido station	Kirihata	1.7	7	6	9	5	346

4.2 Mure and Tonomi district (East area)

It can be said from Fig.3 that there is comparatively a lot of population in this region. The route in this region is thought for room for arranging a more appropriate route for the population distribution. The improvement of convenience by an increase the getting on position can be attempted though the number of passengers decreases by separating the operation route.

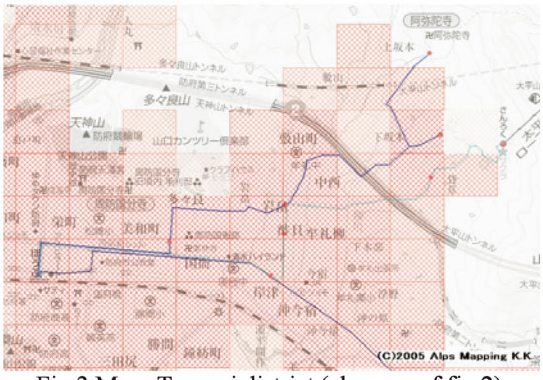

Fig.3 Mure Tonomi district (close up of fig.2)

4.3 Ono district (North area)

The large area route toward Yamaguchi City via Ono region operates it (Fig.4). The route by way of Nakayama starts along the Saba river right bank and by way of Waji Hisakane starts along the Saba river left bank. In the route, there is room for examining the necessity of a timetable revision and substitution and traffic use because users are fewer than routes by way of Nakayama. It is thought that the setting of the route by the DRT (Demand Responsive Transport) is effective

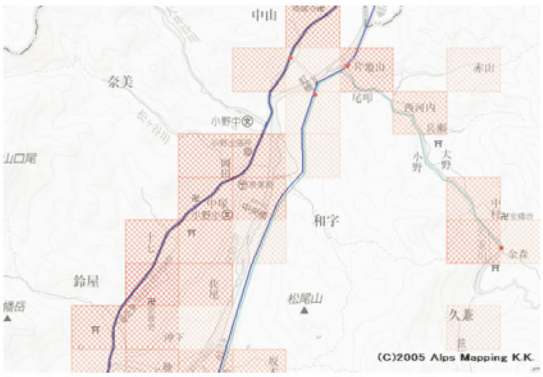

Fig.4 Ono district (close up of fig.2)

4.4 Mukoushima, Nakanoseki and Nishinoura district (South west area)

The route arrangement is along the population distribution, and can be almost said that it is unquestionable from Fig.5. The possibility that there is a problem in the timetable is high if there is no problem in the operation route. Moreover, for the route not to be able to change, and to be able to do nothing but take measures by other methods, the idea includes the use of the DRT though the region where the population is a little is operated about the route toward Mukoushima.

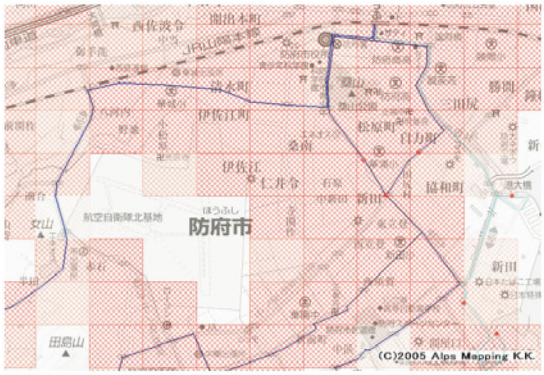

Fig.5 Mukoushima Nakanoseki Nishinoura district (close up of fig.2)

4.5 Migita district (Northwest area)

The route toward Jiyuugaoka and Ochiai via Health Center that toward the Yamaguchi town is operated. As for high demand, the route put from the health center on Ochiai cannot be expected too much in the mesh numerical value that the route passes though the route from Fig.6 to Health Center and Jiyuugaoka is guessed that demand and convenience are high. Therefore, measures are taken by revising the timetable matched to the purpose of use.

It can be said that it is necessary to review the operation situation of the route put on Ochiai from the mesh analysis result. The use of alternative traffic like the DRT is thought when seeing from respect of the demand guessed from the population distribution.

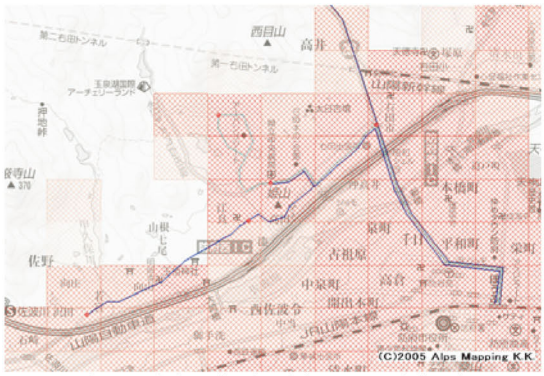

Fig.6 Migita district (close up of fig.2)

4.6 Daido district (West area)

The route arrangement can be said that it is unquestionable from Fig.7. However, because the population distribution of the Kirihata district cannot be obviously little compared with another, and demand expect it very much, measures excluding the operation route change are necessary. One idea includes the use of alternative traffic about the route to Kirihata. At this time, it is necessary to think about the method of connecting the DRT and the shuttle bus.

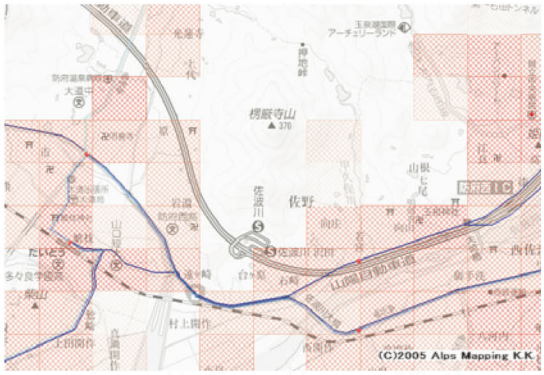

Fig.7 Daido district (close up of fig.2)

5. Conclusions

A public, traffic problem has been analyzed by a brief method that uses the mesh data. It can be said that the demand for public traffic is different because the difference of the numerical value can be confirmed in a surrounding of the station and other remote mountainous area. Therefore, it is more efficient to introduce another traffic system respectively than to operate all whole areas of Hofu City in the route of the same form. It is an idea of establishing two kinds of the route, the one is the round route in the usage frequency district and the other is turns round the region where the numerical value like the population total is low.

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