MSS | City Planning | Kashiwa

Collaboration Projects

"Mobile Spatial Statistics" Supporting Development of Society and Industry
—Population Estimation Technology Using Mobile Network Statistical Data and Applications—

Using Mobile Spatial Statistics in Field of Urban Planning

In recent times, the population structure of inner cities has been changing dramatically, and in order to implement detailed policies, there is a need for intermittent appraisal of the distribution and transitions of a dynamically changing population. However, there has hitherto been no option but to rely on static population statistics such as the national census. In this research, we have performed a field case study in the city of Kashiwa in Chiba prefecture, and we have shown that it is possible to utilize MSS for urban planning. This research was conducted jointly with the Seike Laboratory at the Department of Socio-Cultural Environmental Studies, University of Tokyo (headed by Associate Professor Tsuyoshi Seike).

Research Laboratories

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1. Introduction

As we enter an era in which cities are achieving maturity and their populations are beginning to decline, the population structure of inner cities is now undergoing significant change. Urban spaces and urban services must therefore adapt to the needs of individuals that are becoming more diverse every day. To implement these detailed measures, it is desirable to intermittently appraise the distribution of dynamically changing populations, and the movements of these populations. However, there has hitherto been no means of acquiring actual population movements that are constantly changing, so urban designers have had no choice but to rely on static population statistics such as the populations of residents or employees based on sources such as the national census.

Mobile Spatial Statistics (MSS) is a tool that offers the potential of being able to ascertain the sort of population statistics that are needed for urban design. In this study, we performed a case study in which MSS were utilized for actual urban development, and as result we were able to confirm that it can be put to effective use for this purpose.

This research was conducted jointly with the Seike Laboratory at the

Department of Socio-Cultural Environmental Studies, University of Tokyo (Associate Professor Tsuyoshi Seike).

2. The Need for Population Statistics in Urban Development

This research was performed as a field study centered on the city of Kashiwa in Chiba prefecture, which is the location of University of Tokyo`s Kashiwa campus. Based on the master plan [1] and a comprehensive plan [2] for city planning in Kashiwa, we subdivided urban development into six areas: (1) roads and traffic, (2) land use and habitats, (3) landscape, (4) parks and green spaces, (5) promotion of centers, and (6) disaster/crime prevention. We conducted a survey in Kashiwa city on the current circumstances and needs of population statistics and the themes that currently implemented in each area with the exception of (3) landscape (which is only slightly related to population statistics) and (6) disaster/crime prevention (which is the subject of a separate study). The results are shown in **Table 1**. We performed case studies in each of these four areas to study the usefulness of MSS in urban development.

3. Overview of the Case Studies

An overview of the case studies we performed is described below.

1) Land Use and Habitats: Ascertaining an area's characteristics based on the movements of people at different times and on different days of the week

Based on the land use policy of the Kashiwa City Urban Design Master Plan, Kashiwa city is divided into three areas: a central area, a residential area and a rural area. The central area contains many companies and commercial facilities where people gather during the daytime, and is thus assumed to have a convex population profile (daytime population > nighttime population). On the other hand, many people leave the residential area during the daytime to go to work or school, so this area is assumed to have a concave population profile (daytime population < nighttime population). Fewer people enter or leave the rural area, which is thus assumed to have a linear profile (daytime population ≈ nighttime population). We studied the possibility of ascertaining the movements of people in each area to obtain basic information with a bearing on the study of urban development policies.

2) Parks and Green Spaces: Evaluating the arrangement of parks with a focus on daytime population

By ascertaining the area of park per

Table 1 The need for population statistics in urban development fields

	Basic need for population statistics	Population statistics of principle use	Important future issues	The need for new population statistics
Traffic	・Movements of population (start and end points, route, purpose, means of transport, etc.)	・Survey of personal trips	・Increasing the efficiency of public transport services within the city	・Population movements that allow spheres of activity including neighboring regions to be obtained reliably and easily
Land use	・Permanent population ・Number of commuters to workplaces and schools ・Number of employees	・National census ・Basic resident register ・Enterprise・Corporation statistics survey	・Efficient urban administration ・Low-carbon urban development	・Variation of population in city throughout the day
Parks and green spaces	・Permanent population	・National census ・Basic resident register	・Occupation of park area per capita ・Responding to diverse user needs	・Breakdown of daytime park usage by population attributes
Promotion center	・Visiting population (from residential areas, attributes, purpose, duration of stay etc.)	・State of commerce surveyed by a independent questionnaire (every five years)	・Activation of city center region	・Visiting population can be ascertained easily and frequently from the arriving characteristics of different attributes

capita on a with the resolution of a 1-km grid base using daytime population figures (the time when most people actually use parks), we confirmed that the daytime and nighttime populations are different, and we studied the possibility of using this as fundamental data relating to the study of rearrangement of parks.

3) Traffic: Ascertaining public traffic needs based on the residential areas people come from

By obtaining a breakdown of the population of central urban areas in terms of the residential areas from where people come, we obtained data on where people accessing the city center come from, and at what times of day, and we compared the results with the number of buses operating along these routes. Based on these results, we studied the applicability of the city's internal transportation systems (buses etc.) to the provision of routes in to increase the convenience of the city center.

4) Promotion of Centers: Ascertaining how the city center is visited by people of different attributes and on different days of the week

With regard to visitors to central Kashiwa from inside and outside the city, we ascertained the actual circumstances in detail broken down by time of day and day of the week, and by age and gender to study the possibility of utilizing this information as basic data for promotion initiatives.

4. Case Study Results and Evaluation

1) Land Use and Habitats

We confirmed that it is possible to ascertain population movements in three types of city district — central areas, residential areas and rural areas. As shown in **Figure 1**, we were able to confirm that almost all areas conformed to the trends of convex, concave and linear population profiles for central areas, residential areas and rural areas respectively. Although there were also rural-type areas with convex profiles, we were able to identify special factors that caused these profiles, such as the presence of educational facilities or the presence of railroads or the like. It has therefore become clear that an area's envisaged population movements do correspond with the population movements obtained by MSS. It is thus considered that examining the population movements in MSS provides an indicator for verifying the actual conditions of land use.

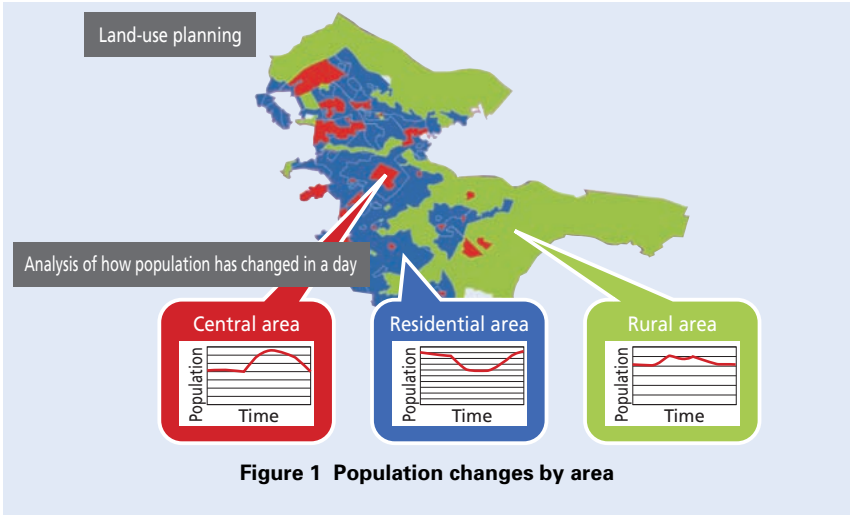
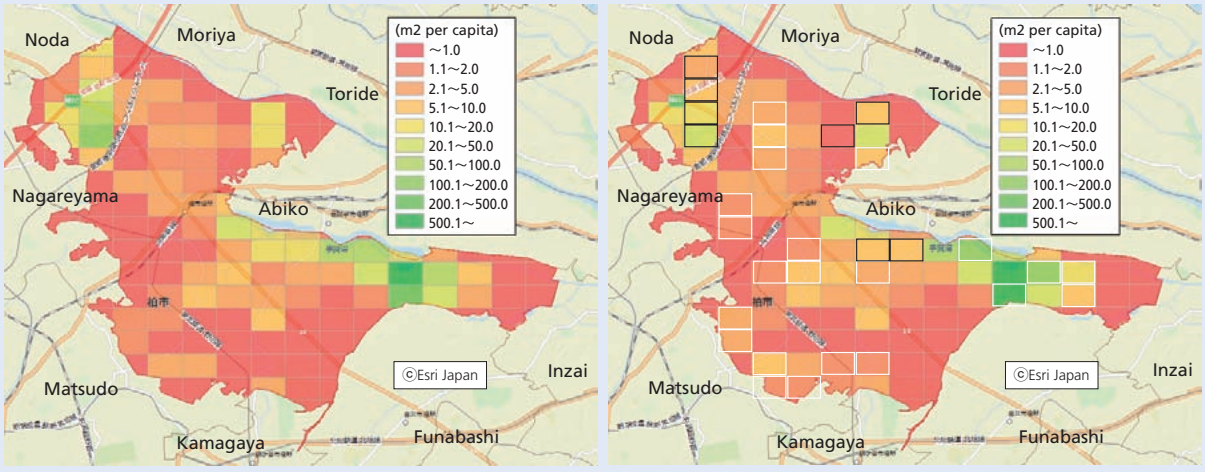


Figure 1 Population changes by area

2) Parks and Green Spaces

As mentioned above, the ratio of daytime to nighttime population has been confirmed to differ widely between areas, so by using population figures for the daytime when more people actually use parks in designs for the relocation of urban facilities that have hitherto been studied by utilizing conventional overnight population figures, it is expected that this will result in facility distribution plans that are more closely matched to people's needs. **Figure 2**(a) shows the park area per capita based on nighttime population statistics, and Fig. 2(b) shows the park area based on daytime population statistics. In Fig. 2(b), compared with Fig. 2(a), areas where there was an increasing tendency of park area per capita are outlined in white, and areas where there was a decreasing tendency are outlined in black. From this result, it can be seen



Source of administrative division map: Digital national land information department (administrative division), Ministry of Land, Infrastructure and Transport

(a) Nighttime population

Source of administrative division map: Digital national land information department (administrative division), Ministry of Land, Infrastructure and Transport

(b) Daytime population

Figure 2 Area of park per capita of population

that the park area per capita increases in some areas and decreases in others between daytime and nighttime, while overall there are more areas where there is an increase during the daytime. Therefore, in redistribution plans aimed at striking a good balance of park area per capita, it seems that it is more effective to use daytime population figures.

3) Traffic

The results of estimating population movements from each of the city's residential areas in the city center were plotted on the same map as data on the number of bus routes to the city center operating from each bus stop. As shown in **Figure 3**, we were able to identify regions from which a large number of people move to the city center but where there are few bus routes that access the city center directly. However, since MSS are not able to ascertain the routes or means by which people actually travel, this information has to be gathered by methods such as questionnaires and interviews. It is also

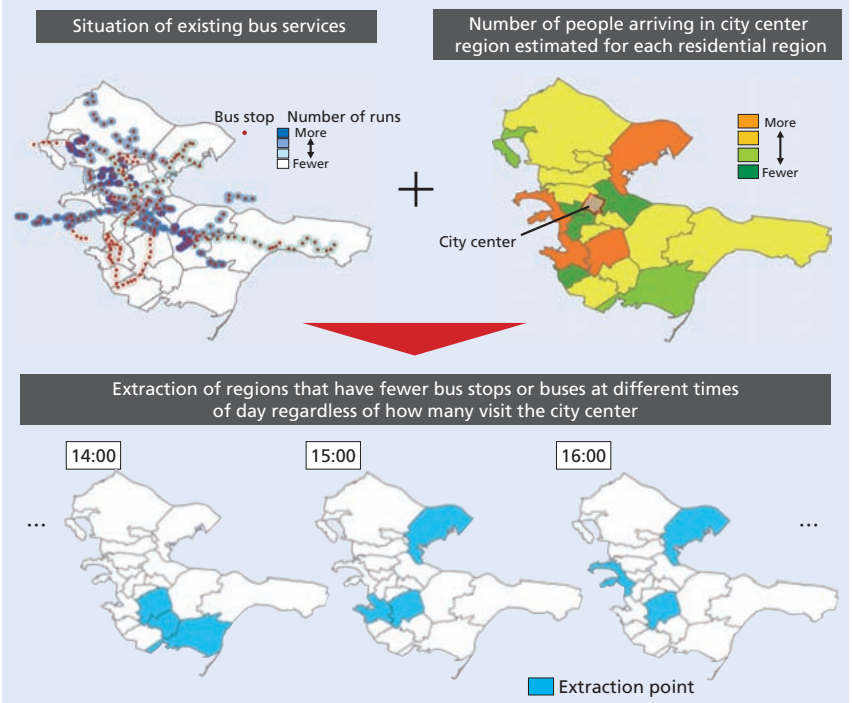


Figure 3 Comparison of bus operating conditions and the numbers of people that visit the city center

necessary to analyze the conditions of other transport organizations besides buses.

4) Promotion of Centers

The arrival of women in the city is of particular importance to commercial development. To obtain this information, we performed separate evaluations of population movements among women from each residential city, town and village on weekdays and at weekends. It should be noted that MSS include all individuals including those traveling to work or to school, people at work and people just passing through. However, as shown in **Figure 4**(a), there was no large change between weekdays and weekends for the cities of Matsudo or Abiko, whereas the number of people arriving from Nagareyama was found to drop sharply at weekends. It can thus be inferred that the visitors from Nagareyama city include a greater proportion of weekend shoppers and than weekday commuters and students. In this way, we found that it is possible to infer trends in the numbers of shoppers by comparing the populations on weekdays and weekends, even though it is not possible to know the purpose for which each individual person came to the city.

We also ascertained the populations of women that spent all day in the city center area on weekdays and at weekends, broken down into age groups. The results for the top three age groups are shown in Fig. 4(b). This shows that the number of women in their 20s increases substantially at weekends compared with weekdays, while in contrast the number of women in their 60s decreases sharply. It can thus be seen that when weekdays and weekends are considered separately, there are large differences between the characteristics of different age groups. By ascertaining the characteristics for different times of day and different days of the week, it is expected that it will be possible to implement detailed urban stimulation measures to suit particular regions, age groups and genders. Furthermore, by making use of other data such as the results of questionnaires and interviews to ascertain details that cannot be obtained by mobile spatial analysis (e.g., the items people buy and the prices they pay for them), it should be possible to compare corresponding sets of data to make them more complete and robust.

5. Conclusion

We have conducted four case studies to evaluate the usefulness of applying MSS to the field of urban development, and we have identified the issues that need to be addressed. It seems that the most useful benefit is the ability to ascertain population movements over a single day, especially the daytime population. Also, by determining the visit-

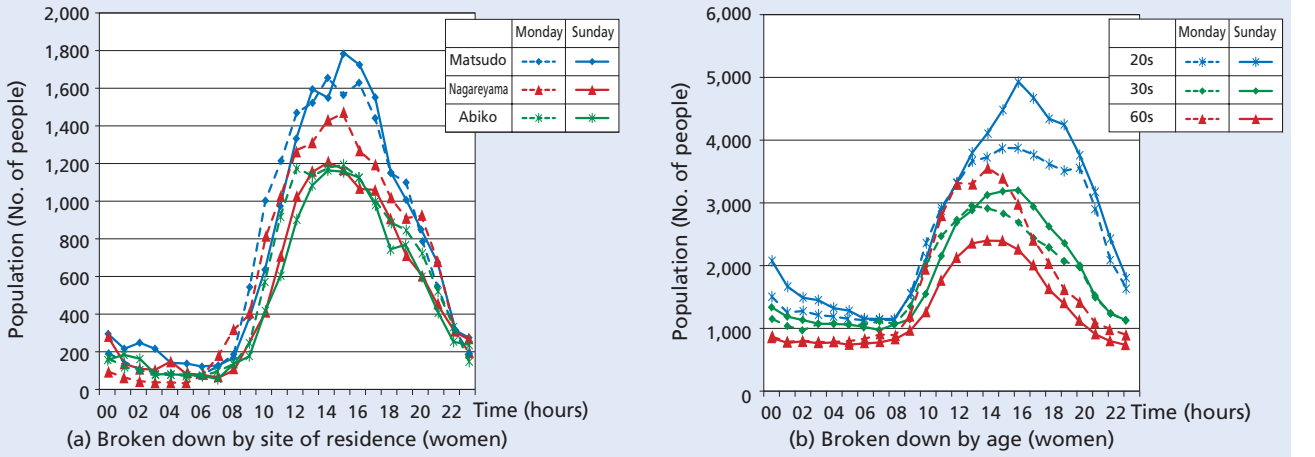


Figure 4 Characteristics of visitors to city center region

ing populations from different residential areas and the populations of different age groups and genders, it is expected that it will be possible to implement detailed policies according to people's region, age and gender. However, it must be kept in mind that population movements are affected by factors that exhibit specific tendencies, such as the presence of education facilities and railroads. Also, from MSS, it is not possible to ascertain details such as the means of transport that individuals use when going out, or their objectives when doing so.

In the future, we plan to continue our practical study of the urban development field based on not only the utilization of MSS themselves, but also the effects of linking the results with other sources of data.

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