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The applicability of mobile positioning data in urban planning survey

Chen Yu[1], Chen Yanping[2]

[1-2]*Shenzhen University*

[1]*zsu_chenyu@hotmail.com, szuchenyu@szu.edu.cn*

[2]*chenyp@szu.edu.cn*

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Urban planning survey is a comprehensive and complicated procedure. The traditional means of urban planning survey, such as questionnaire, interview and travel log, etc., are facing the limitation of high cost, small sample size and objective bias. However, as the rapid development of ICT (information and communication technology), the application of big data on the study of urban planning become more and more popular. The common data sets used in urban planning include mobile positioning data, float car positioning data and mobile check-in data, etc. The application of big data in urban planning survey complements the shortage of traditional means in reducing survey cost, increasing sample size and providing a more objective perspective.

Mobile positioning data is one of the most common data sets applied in urban planning survey. The literature review shows that mobile positioning data are usually used in studying urban planning from a macro-scale perspective, such as the spatial structure of a city or even the spatial relationship among cities in a region, while there is few applications from meso-scale and micro-scale perspectives. However, the application of mobile positioning data in a meso level or micro level is equally important as in a macro level. For example, the data could be used to study the problem of residential-working spatial relations, commuting, urban land use, etc.

In this study, we attend to discuss the applicability of mobile positioning data in urban planning survey from a micro-scale perspective. The study shows that the applicability of mobile positioning data in a micro level is influenced by two main factors.

The first one is the spatial positioning error caused by the data collection method. The position information collected by the communication service company is not the actual position of the mobile phone, but the position of the base station which connecting the mobile phone, in most situations, the closest base station. So researchers usually use the method of Voronoi (Thiessen polygons) to simulate the coverage of a base station. However, the method of Voronoi only consider the factor of distance from the mobile phone to the base station, while in the real world, the communication between a mobile phone and a base station is affected by other factors such as the angle of antenna, the strength of signal, the blockage of buildings, etc. Therefore, the coverage of a base station is not necessarily equal to the equivalent Thiessen polygon, which cause more unexpected spatial error between a mobile phone and its equivalent base station. It's logically believed that the more base stations included the less overall error will be. That is why most studies are conducted in a macro level.

The second factor is the mobile phone users' behavioral patterns and the land use condition of the research area. The mobile positioning data indicate the temporal-spatial information of the mobile phone users. Studies usually assume that users spend their daytime in working and spend their night in home. But in a diversified world, there are employees who work on shifts, meaning some of them may work at night. And in some creative industries, employees are more likely to work on flexible time. In order to apply the mobile positioning data on such situations, it require us to understand the behavior pattern of the mobile phone users in the research area. Moreover, in a mix-land-used area, it is hard to distinguish the activity pattern of the users in the area using mobile positioning data, since different activities may present the same data characteristics.

We take High-tech Park in Nanshan District, Shenzhen, China as a case study to show how these two factors influence the applicability of mobile positioning data in urban planning survey from a micro-scale perspective. The results indicate that: (1) according to the spatial positioning error of the data and the diversity of users' behavioral pattern and land use pattern, the applicability of mobile positioning data in urban planning survey from a micro-scale perspective is subject to the scale of the

research area and the knowledge of users' behavioral pattern and land use pattern in the area; (2) an research area including more base station will increase the applicability; (3) an research area greater homogeneity in users' behavioral pattern and land use pattern, an industrial park for example, will increase the applicability. The study implies that in order to apply mobile positioning data in urban planning survey from a micro-scale perspective, traditional ways of urban planning survey, such as questionnaire, interview and travel log, etc., is necessary so as to understand the users' behavioral pattern and land use pattern.