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## Geographical Perspective in City Sensing

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### Abstract

In city sensing there are many methods for capturing people's movements and city crowdedness. Each method has advantages and disadvantages. This paper argues that geographical phenomenon like spatial segregation can have a major influence on the results in fixed sensing therefore a structured location choice is needed. Mobile positioning as a new technology data collection method opens up great possibilities in city sensing.

### Author Keywords

Spatial segregation; mobile positioning; fixed sensors; city sensing

### ACM Classification Keywords

J.4. Social and Behavioral Sciences : Sociology.

### Introduction

People use space for different purposes [2] which depend on their personal socio-demographic characteristics, demands and goals, structural constraints (work, school etc) [5], and also issues related to accessibility. In terms of a city, the space can be divided according to its functions: it can be a public space, working space or residential space. In an era of

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globalization, international migration has become more intensive than ever before, which is an important source of socio-cultural diversity. It can also often lead to problems related with immigrant's participation in the host society. The circumstances where and how different population groups live, move or interact with each other has lead to a wide range of spatial segregation studies in geography. Spatial segregation is traditionally defined as a process through which socially defined groups become spatially separated [6]. Thus I find the spatial segregation to be a very important aspect which should be taken into consideration when assessing the people's movements inside the city. I also support the idea to use methods based on new technology in order to capture the dynamics of today's city.

### **Spatial segregation as an important aspect in city sensing**

The spatial separation of different groups has been traditionally measured in the residential space, now the literature clearly states that individuals can experience segregation in different socio-geographical spaces (residential, work, leisure) in various scales [9, 3, 8, 4]. In other words, certain social groups tend to concentrate in different spaces with the members of a similar or the same group. The effect of spatial segregation has a major influence on person's life and on the participation in the society in social and economical terms, which is particularly manifest in the public space [7]. For example the public space in the city centre and in the suburbs can be used by different social groups, because the nearby residential space is inhabited by different people. According to literature [3] metropolitan edges in Los Angeles are inhabited by the white ethnic majority, while the downtown and

more deteriorated areas are home for immigrants. Deriving from this knowledge, it is important to carefully choose the locations where to set up the sensors in order to get the accurate information that is necessary for further generalizations. Considering the selected places for sensors the results might be different. Of course, one can argue that the location choice for sensors must be chosen among the public space, where the spatial integration between different social groups is supposed to be higher [7] than in other spaces, and this way it is possible to get the most accurate data about spatial behaviour of city's inhabitants. Although public space can be the most integrated space in terms of people's socio-demographical characteristics, it is still important to keep in mind the regulations or structures that might hamper the spatial accessibility of certain social groups, which can in the end lead to over- and/or underrepresentation of certain people. This might be a problem, as different groups (ethnic, age, gender etc) are behaving differently: they visit different shops, recreation places or museums. What can be interesting, for e.g. to ethnic majority, will not always amuse the minorities, therefore differently placed sensors can give different results. However, the outcome of the analysis depends heavily on the overall research goal, whether the research object is the spatial segregation *per se* or the city's overall mobility processes. The interpretation of the data considering the crowdedness of the city or spatial mobility should always consider the possible effect of spatial segregation.

However, it is relatively difficult to determine the characteristics of observed people when using fixed sensors. It is clear that the background information must come from secondary data sources. One

possibility is to choose the locations for sensors among space-units which are inhabited by people with relatively homogenous background. The data can be derived from e.g. censuses. The disadvantage of this approach is the "static" nature of census data – as people are very mobile in spatial and social terms, the data collected, for example, seven years ago can no longer be representative. The more dynamic ways for identifying the people passing by the sensors can incorporate the devices or documents that are daily carried along. These can be mobile phones, WiFi devices, public transport cards etc, which are also secondary data sources. Besides using fixed sensors, there are also other possibilities for capturing people's spatial movements and city crowdedness. This is discussed below, focusing particularly on mobile positioning.

#### **Aspects related to data collection methods**

In today's technologically developed societies almost each person has a „digital“ footprint in different databases, which can be a possible data source for researchers. Besides the traditional sources (censuses, questionnaires), there is a wide range of new methods, such as satellite-based and mobile positioning (e.g. [1]) which give more real-time and dynamic data about short-term mobility and spatial behavior. The fact that different devices, e.g. mobile phones are becoming more pervasive in today's society makes them possible data sources for people's movements. With this kind of data it is possible to shed light to many aspects in the human space-time mobility that remains undiscovered. For example, it is possible to get the census data with 10 year accuracy, but mobile phone data's time interval can be measured in minutes and hours. Furthermore, the more precise spatial accuracy is also one aspect that creates greater possibilities for detailed research. It gives

more opportunities for investigating the aforementioned spatial segregation topic from different angles. Firstly, it provides person's entire movement information, therefore making it possible to investigate also the leisure and work time segregation. Secondly, because of the short time interval it is possible to capture how the spatial segregation rate changes in the course of time. Along with the positive sides come, also the security issues and problems that can limit the access to this kind of data. On the other hand, it is important to stress that traditional and „static“ data sources (censuses, questionnaires) are still very necessary as they are overwhelming and representative data sources, considering the total population. This aspect is, in my opinion, one of the biggest weakness of the new technology data sources, as it depends heavily on the calling habits of the device users. For example, on New Year's Eve people tend to make more phone-calls (and therefore more people leave a digital footprint in the database) than during Easter, which raises the question, how comparable these two days are and how representative is the data. The issue of representability is an aspect that needs special attention in developing methods.

#### **Conclusion**

To conclude, in urban studies it is important to pay attention to the effects of spatial segregation, which can have a great effect on the analysis results, because people tend to spend their time with the members of similar social groups. Along with aforementioned aspect comes the overall representability issue that is relevant to new data collection methods. However, it is very important to apply new technologies in data collection, as it enables to discover new patterns and aspects in human mobility and spatial behavior.

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