

Analyzing and Modeling Spatial Change – Space Time Geography

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Introduction

Studying space-time activities has been a major part of urban modelling. Analyzing the information of what people do during a particular time interval and in what part of the city, can potentially help decision makers come up with better models. From the very beginning of civilization, rulers/officials have planned their cities in a particular way in order to facilitate their citizens with better infrastructure. In order to do so, many geographers and city planners have come up with urban growth models, that solves some particular issues of urban planning and urban growth. Our cities have been growing with time and so has been the technology we depend on. In modern world, with abundance of modes of transportation, our cities exhibit complex patterns of movement (Fei Su, 2016). But owing to the technical advancements, we now have software and tools that could help us analyze those complex trends and get some meaningful information out of them (Andrienko, Andrienko, & Wrobel, 2007). This paper focuses on one such concept of GIS, the space-time interaction of people. With access to precise and cheap GPS systems, we now have ability to track a person's movement all day long and analyze what different tasks does he/she carry out throughout the day. One of the best use that we all witness daily is the traffic movement during the rush hours. If the city planners have the movement data from the riders, they would know how many people take which road to get to their destination or take which train to get to their workplaces. As activities occur in both space and time, it is essential to treat space and time in a combined manner (Chen, et al., 2011).

Study Design & Data

Following the trend in space-time analysis, I wanted to analyze my movement with a couple of other folks in the common areas of the university. Since, we all leave our house at different times, attend different classes and meet for lunch in the common area, I thought it would be a good dataset to work with. But due to the complications of tracking devices on different operating system platforms, the data collected was not sufficient for my analysis. Also, my dataset lacked the tracks when I took the subway since the GPS signal was lost for that time. Since I couldn't use my data, I downloaded tracks for a person through open street map platform, as he records his bike rides to Cross Creek Ranch, a fancy township in the city of Fulshear, Texas. I found the dataset interesting because of the time consistency between the days and the different parts of the suburban town that is probably inhabited by the well-off working-class families,

who probably use cars for their commute. I could ideate similar trends in the traffic scenario I talked about in the introduction part, as the time of the travel coincides with the evening rush hour and the person could be exploring new ways to avoid the busy streets and see new places. It's also interesting to see how that person tries to cover the periphery of the township.

Analysis

The analysis of my project was based on ArcScene, which is the 3D visualizing tool for our maps and data. The task on the software was to convert the data to shapefiles and import it as a 3D object. Figure 1 shows the overall analysis for the 4 days of data I got from open street map. One of the issues I had with ArcScene was that, if the coordinates are too close to each other, you won't be able to see a proper trend in the data. We can surely see some changes when zoom into the dataset as shown in Figure 2. The analysis shows the start of the trip and then the slight variation in geography as the time proceeds. In second figure, we can see some of the data points converging which represents common path for the trips. The difference between the start and the end time of the bike rides is about 40 minutes, so we could assume that the person takes the ride for fitness purpose. It's interesting to see from Figure 3, how that person tries to cover every part of the township using one of the main roads. The roads in the township could be considerably empty or has designated bike lanes because the rider takes main roads for his bike rides every day. We can also see some overlap in the tracks which could be the areas near his/her residence or common streets to get to different parts of the township.

Conclusion

The space-time analysis helps us understand different patterns and changes over time for the people under consideration. We had good amount of data to understand how a person uses a particular space in a given time frame. Some of the assumption we had for our space-time analysis holds true in the dataset we considered for this project. The rider shows different pattern for each day of the week which represents he/she likes to explore new areas. The rider bikes around the same time on these 4 days i.e. around 5:30 P.M., so we could assume that the person works somewhere in the day time. So, these are the trends or information that we can get from space-time analysis. To better understand the problems of our growing city, analysis of which areas are crowded and when, would help city planners design spaces that could accommodate the crowd. Analysis of traffic on roads or ridership on trains after a major game can help curb the jams and overcrowded trains. People behave differently at different time and this could be shown clearly from their traces as an otherwise normal person could become furious and drive rash during the rush hours. In conclusion, the space-time analysis is a good way of studying the spatial change at micro level as with advancements in technology, every person's traces could be captured and fed to the model.

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Appendix

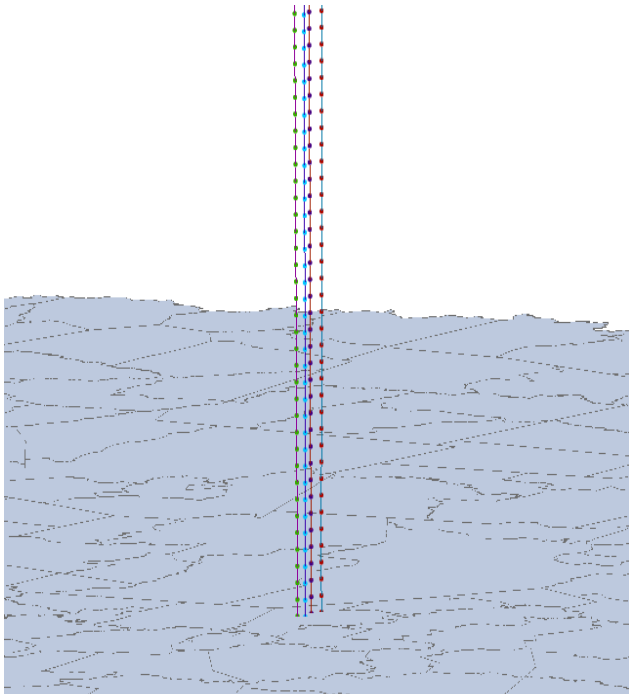


Figure 1: Overall Space-Time pattern



Figure 2: Converging trends in space-time pattern

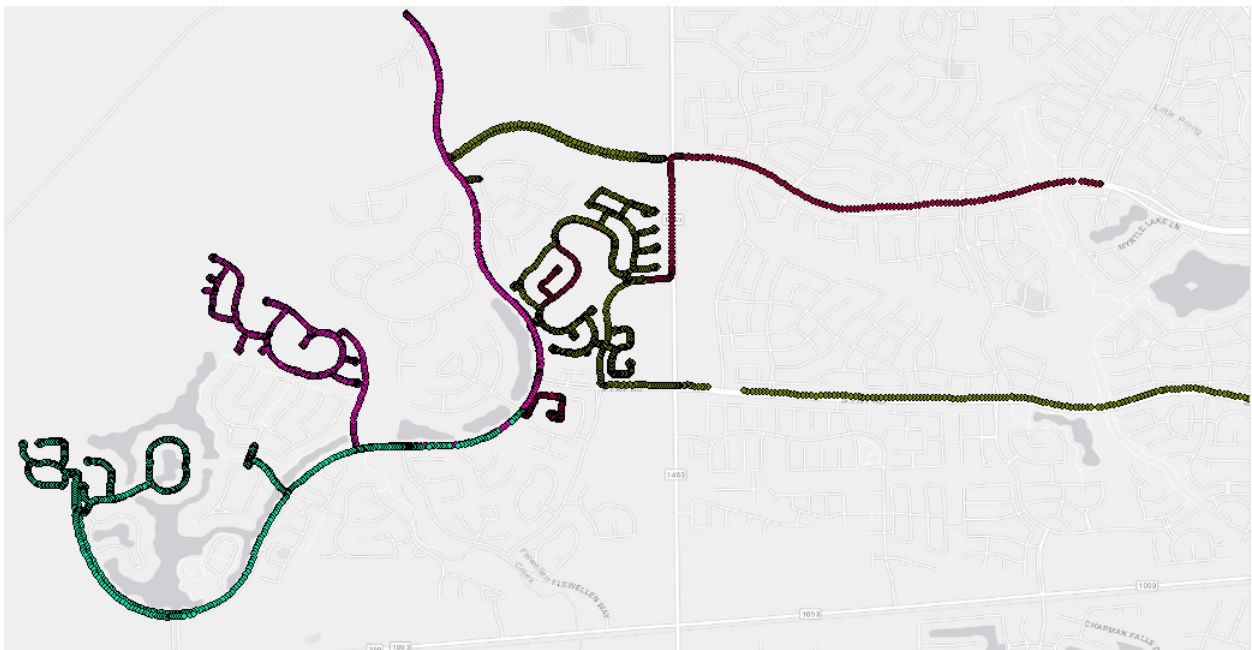


Figure 3: Routes taken at Cross Creek Ranch