Place Syntax Tool (PST)

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Background

Accessibility research of human behaviour has always been limited by the kind of data and analytical tools available. For example “there was no effective means for representing or dealing with the spatial complexity of a realistic urban environment”, neither did past studies “incorporate data about a person's cognitive environment into the analytical framework” (Kwan, 2000). In the past decade many steps have been taken to overcome these limitations, for example, `instead of using the straight-line distance between two locations, the actual travel distance over the transportation network can be used' (Kwan, 2000). Kwan *et al.* (2003) state that still much remains and especially the understanding of our cognitive environment is pointed out to be a crucial issue.

The most important background to the Place Syntax Tool (PST) and the theories of Place syntax is the shortcomings and strengths of space syntax methodology. The strengths consist of a strong empirical theory of cognitive space and cognitive distance, measured in changes of directions, so called axial line steps. However, within space syntax research accessibility is measured only within the network of axial lines with no attractions. This led to the idea to add attractions such as density or transit points to the spatial model to get better predictions of pedestrian flow but also new interesting measures of accessibility. In many planning projects where space syntax was used the issue of attractions came up when describing centrality and proximity. Place syntax has been a natural answer to these questions. Very simply put, Place syntax is adding attractions to Space syntax.

Conceptual framework and theoretical underpinnings

Accessibility is a widely used spatial analytic measure defined as “the relative ‘proximity’ of one place *i* to other places *j*. In generalised terms, the measure can be defined as:

$$A_i = \sum_j f(W_j, d_{ij}) \qquad (1)$$

where W_j is some index of the attraction of *j* and d_{ij} is a measure of impedance, typically the distance or travel time of moving from *i* to *j*” (Jiang *et al.,* 1999). From this definition it is easy to see how space syntax does not deal with the full concept of accessibility, in that one rarely deal with W_j or any indexes of place attraction.[1] Another way of putting it is that geographic accessibility deals with ‘places’, where ‘place’ simply means a geographically specific space, a location, or a space with a specific content, while space syntax deals with ‘spaces’, i.e. spaces or locations with no specified content and thereby no measurable attraction. This straightforward distinction, between space and place, can be said to be the basis of what Jiang *et al.* (1999) distinguish as ‘geographic’ and ‘geometric’ accessibility.[2] Hence, if geographic accessibility is the proximity of places, then geometric accessibility is the proximity of spaces, i.e. setting $W_j = 1$. This can be defined as:

$$A_i = \sum_j A_{ij} = \sum_j f(d_{ij}) \qquad (2)$$

From this we can see exactly why space syntax from the point of view of spatial analysis is a special case of geometric accessibility.

Defining how to measure d_{ij}, the ‘distance’, ‘transport cost’ or ‘energy effort’ to move from *i* to *j*, is then obviously a critical part of a accessibility measure, and in a geometric accessibility measure *the* critical part. The most common distance units used within accessibility research are: topological steps in a network, metric travel distance, travel time, travel cost and monetary charges. But it is exactly concerning such descriptions and

[1] As discussed in the introduction, this is one of the points with space syntax, trying to develop descriptions whereby the architectural variable can be controlled.

[2] What is called ‘geometric’ here seems to come close to what is also known as ‘pre-geographic’ (e.g. Miller 2000).

measurements of distance one have encountered problems within spatial analysis when moving from the comprehensive level of geography to the detailed level of urban settings: “what is dramatically absent are tools for developing accessibility measures at fine spatial scales which involve the geometry of urban structure in terms of streets and buildings in contrast to the measurement of accessibility at the geographic or thematic level”, (Jiang *et al.*, 1999).

It is here that we propose that the morphological descriptions developed within space syntax can prove useful and can contribute to accessibility research. Hence, the ‘axial map’ developed within space syntax research, an example of topological steps in a network, is a better measure of distance for certain critical issues of accessibility than for example metric travel distance.

Operational aspects

Together with a group of students at the Department of Numerical Analysis and Computer Science at KTH, we have developed the Place Syntax Tool (PST), an application for the desktop software MapInfo. The PST consists of two main components, MapBasic (MB) and Dynamic Link Library (DLL). The MB component is written in MapBasic and implements reading and writing in MapInfo's own databases. The DLL component is written in C/C++ and is compilated as a DLL. It takes care of the graphical user interface (GUI) and does the accessibility calculations. The two communicate through a communication interface integrated within the DLL. The GUI has two main windows. In the first window all tables are selected: input place data (plots or address points) and output place data (where the results will be distributed: plots or address points), axial lines and `unlinks' (points where crossing axial lines do not connect), links (e.g. address points which link plots to closest axial line).

The second window is for selecting the type of analysis and consists of five pages. In the ‘Calculation type setting' page you can choose to calculate from all places or just from a single place. In the 'Criteria settings' page the column for desirable place data is selected. Here you can choose multiple columns. Data can also be normalized and given a relative weight. In the `Result settings' page you choose how results are displayed, in a table or on a coloured map in MapInfo. Here there is also a critical section where you decide how data on input place data are distributed to the address points, divided with the amount of address points or the full value to all. Similar to that, the output place data has to be determined, whether they are to collect the mean, max or min of the result values at the address points (that is if you do not choose to display them on the address points). In the `Table Column Keys' page you select the key columns that connect, e.g. address points and plots. The time for running a small city analysis would be typically a couple of seconds.

Relevance for planning practice

We believe that the marriage between spatial analysis and urban morphology that place syntax represents can bring with it certain fruitful theoretical implications. By taking as its point of departure a geometric element, the axial line, that is defined from the point of view of an experiencing subject rather than a more abstract element, (such as street-crossings or bus-stops), the place syntax approach actually turns a lot of things upside down. As earlier argued, many descriptions of accessibility of today are conducted from a pronounced system point of view, partly because it has fit existing descriptive techniques, partly because it has fit existing needs, which primarily has been formulated by large bureaucracies and corporations. Place syntax then introduces the possibility to also conduct descriptions and analyses of accessibility from a life-world point of view in just as systematic and quantitative a way. The effect in our opinion is nothing less than a possible displacement of power.

In many concrete urban planning situations system world descriptions (administrative) and life-world descriptions (user) contradict each other, but since system descriptions usually have more powerful quantitative foundations and life-world descriptions rely more on ‘weaker’ qualitative descriptions, the former turn out to be the stronger part. In a study by Ståhle (2005) it was shown that the access to parks and green areas perceived by the citizens contradicted the measures by the planning authorities, which measured this as hectare of park and green area per person. When instead the accessibility was measured, using among other parameters axial distance rather than travel distance, perceived access and measured accessibility correlated. The argument was made further critical by the fact that the city districts where the citizens’ access to park and green areas was perceived to be low, were rather low status post-war suburbs, that by the planning authorities were understood as ‘green’, while the city districts where the citizens’ access to parks and green areas was perceived to be high, were quite dense high status inner-city districts, that the planning authorities were understood as ‘grey’. According to existing measurements there was no need for new or better parks in the post-war suburbs then, while that could be the case in the inner city. The new place syntax measurements could hence show that there existed “more park space in a denser city” and at the same time give quantitative voice to the perceived

lack of park and green areas in the conceived 'green' areas. In extension this fundamentally alters both power relations in urban space as well as urban planning and design practice.

Strengths and limitations

With these fundamental findings as a background we believe that the 'place syntax' approach has great potential for the development of new tools for urban planning and design, not only for predicting pedestrian flow or estimating urban accessibilities, not least to redefine the concepts of densities and areas. The aim of the research is to help urban studies and practice to find new and possibly more informative ways or presenting place data in general. These new realms of geographic accessibility analyses with axial lines are however so diverse that only empirical investigation will show their usefulness. Even so we would like to sketch some rough categories of application.

- Between different categories of spaces: This means extending integration analysis to other categories of spaces than those represented by axial lines, such as points (e.g. address points) and districts (e.g. plots). It offers the possibility to for example analyse 'configurative constitution', i.e. the number of entrances within a certain radius, or 'plot configuration', which would be the number or the total size of 'accessible' plots within a certain radius;
- From all places to an attraction: This means calculating the number or the sum of the value of a specific attraction within a specific radius from all places. This implies a 'supply' or LOS (Level of Service). It could for example concern the number of shops, or the amount of green space. These could furthermore be combined into a possible measure of urban attraction;
- Between the same attractions: This means calculating the number or the sum of the value of a specific attraction within a specific radius from the attractions. This could be a measure of 'clustering' of attractions or possible competition/cooperation between businesses,
- Between different places/ attractions: This means calculating the number or the sum of the value of a specific attraction within a specific radius from another attraction. This can be for example used for linking households and jobs, people's accessibility to work etc;
- Place population: This means calculating the number of people within a specific radius from all places. This can, as shown in this article, be used for pedestrian movement prediction. But it could also be a means to analyse for example the size of local economical markets;
- Attraction population: This means calculating the number of people within a specific radius from an attraction. This obviously is an extension to the category above and could be used to analyse for example the number of potential customers to a particular shop location or the potential amount of visitors to a park.

This said, it is obvious that as with all analyses of accessibility and configuration there are complexes of qualitative factors that are difficult to take into account, as put forth by Kwan *et al.* (2003) among others. Desyllas *et al.* (2003) have tested to integrate street width, adjacent retail and accessibility to underground stations in a pedestrian demand model. Other factors are of course car traffic barriers, safety, noise levels, air quality, identity etc. These factors furthermore affect different users such as children, elderly, disabled etc. to different degrees. Kwan *et al.* (2003) even emphasizes that also the individual level (personal accessibility) has to be taken into account. Still we believe that the rather straight-forward approach of place syntax analysis balances well between rather simple in-data and precision in out-data at the level that is most useful in urban planning and design.

References

Batty, M. (2003). *A new theory of space syntax*. Working Paper 75, Centre for Advanced Spatial Analysis, UCL, London.

Jiang, B. and Claramunt, C., (2000). An integration of space syntax into GIS: New perspectives for urban morphology. Transactions in GIS, Vol. 6: 295-307.

Kwan, M.-P. (2000). Analysis of human spatial behavior in a GIS environment: Recent developments and future prospects. Journal of Geographical Systems, Vol. 2: 85-90.

Kwan, M.-P., Murray, A.T., O'Kelly, M.E., Tiefelsdorf, M. (2003). *Recent advances in accessibility research: Representation, methodology and applications.* Journal of Geographical Systems, Vol. 5: 129-138.

Marcus, L. (2000). Architectural knowledge and urban form: The functional performance of architectural urbanity. Ph.D. thesis, KTH School of Architecture, Stockholm, Sweden.

Miller, H.J. (2000). *Geographic representation in spatial analysis*. Journal of Geographical Systems, Vol. 2: 55-60.

Figures

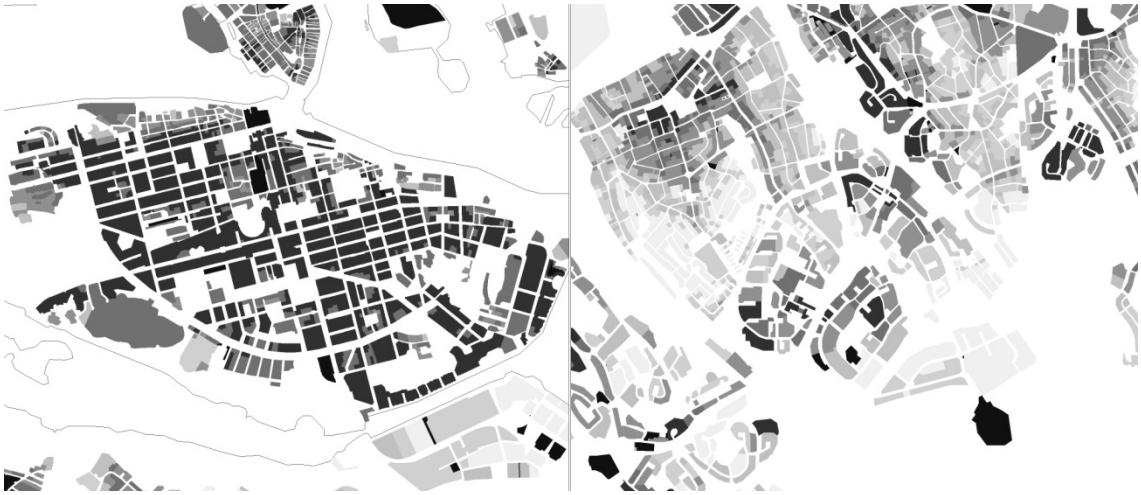

Figure 1 Closest food store within axial lines. Maps are comparable in terms of colour. (Darker is shorter distance)