Syntax2D: An Open Source Software Platform for Space Syntax Analysis

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   Abstract. For space syntax researchers, software is an essential tool for the analysis of spatial configuration. Unfortunately, the proprietary nature of most of this software can inhibit innovation within the field. Without the ability to examine others' source code, we lose a potential resource for learning and an additional point of verification for peer review. Moreover, without a common base of code, researchers must constantly duplicate existing efforts when developing new software. As a result of proprietary policies, many spatial analysis programs end up limited in scope and become difficult to maintain as their authors move on to other research. The development of space syntax is hindered as long as software remains closed and fragmented. Towards this end, the University of Michigan has developed an open source platform for spatial analysis: Syntax2D. This software currently features a robust interface, combining existing measures such as isovist, graph, and axial analysis with newer features for path analysis. Our goal is for Synax2D to become a collection point for researchers, unifying different methods of analysis within a single application. With the software and source code freely available, Syntax2D is an opportunity for the space syntax community to share and build upon their work across a common framework.

1   Overview of features

Our objective of the first version of Syntax2D is to lay the framework for future development. At this early stage, we are more interested in incorporating existing measures and establishing a workable interface between them than in pushing the limits with new features. Therefore, on the surface, it would seem there is not much to distinguish Syntax2D from other recent spatial analysis programs. It meets the basic needs of space syntax research with isovists, axial maps[1], and grid / VGA analysis. Users can import .dxf files and export data to .csv. The interface features mouse, pan, and zoom, and visualization layers that can be toggled on and off. Although it may not yet have the depth of features of existing programs, this version is fully capable. Students at the University are currently using Syntax2D for their research.

   One of our original contributions is the inclusion of new path-based measures. While the computer modeling techniques of spatial characteristics are being continuously refined and improved, the representation and analysis of how people move are still carried out using manual methods. Syntax2D quantifies traces of people paths so that these can be tested against spatial values as well as data obtained from observation studies. Users can load a path from within a drawing and use it to generate isovists from a series of observation points. From here, the cumulative isovist of the path is shown and the data from each of these points is analyzed according to several measures. Another option for this tool is to generate isovists with a user-specified cone of vision. Syntax2D is capable of representing data visually from the point measures, as well.
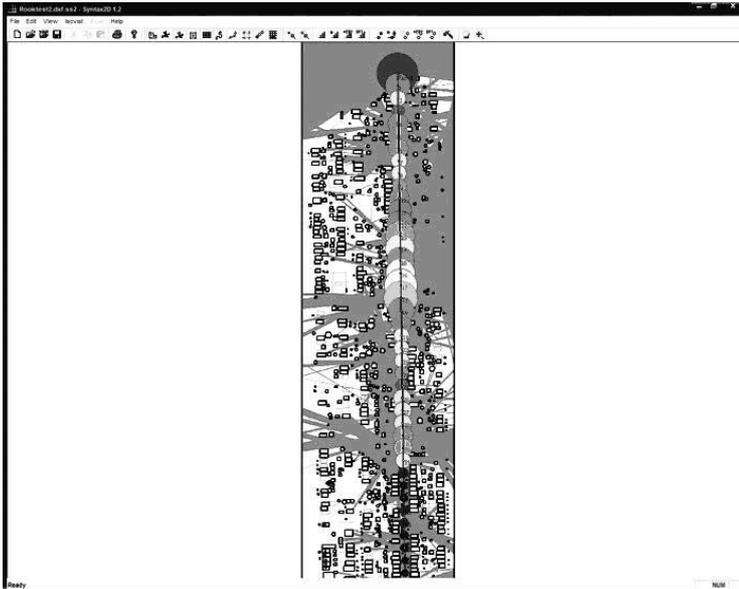
Figure 1: A path isovist visualisation showing area values

For example, the area value of each isovist can be displayed as a colored circle along a path (figure 1). A greater radius and a red hue might denote a larger relative isovist area. Finally, we have included a path-counting tool that can count the number of times a path crosses a VGA cell, and a point-counting tool that will count how many points appear in each VGA cell. These tools have already proven to be great time savers in our own research. In the future we will add output measures related to a number of behavior characteristics, such as direction seeking and direction change in a navigable space. Each cell is given an attribute based on such measures. The results can be statistically processed and interfaced with data from visibility analysis. The usefulness of this tool and its applicability in studies looking at human behavior is widely significant providing a platform for a detailed study of the relationship between syntactic variables and the complex aggregate patterns of movement.

In addition to this set of features, there are several minor improvements of note. Within the point isovist tool, users have the option of subdividing isovists to obtain additional measures. Our visibility analysis automatically detects enclosed spaces and offers complete control of both grid spacing and starting point. VGA visualizations have full color depth and display a reference scale (figure 2).

While this is an early version, we think it shows great promise. In the long term, we hope to improve the depth of the software with a greater variety of measures and its breadth with more analysis types such as J-Graphs. Ultimately, we hope that researchers will find Syntax2D useful enough that they would like to help us improve upon it.

2   Licensing and development

Syntax2D is free to download from the University of Michigan so long as users agree to the terms of the open source license. This allows the user to install and run the program for academic research as well as to view and modify the source code[2]. Users are under no obligation to share
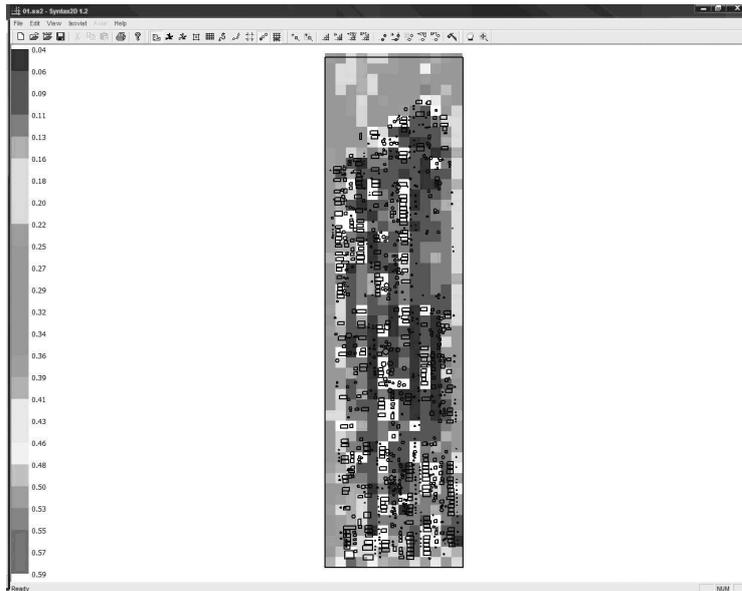
Figure 2: VGA analysis with full color depth and a reference scale display

any modifications they make, but cannot re-release programs containing Syntax2D code in the form of commercial software. Papers published using software derived from any Syntax2D code must cite the authors of the original code.

With the introduction of the software, the University will be launching a website where users can discuss their needs and coordinate their own development efforts. This site will host the full archive of all future revisions of Syntax2D, as well as supplemental documentation and tutorials. In time, we hope that users will contribute to the website, both as members of an active learning community and as co-developers of the software.

Development of the software will follow a model similar to that of Linux, whereby user-submitted suggestions and code are vetted by a committee and then incorporated into the "official" version of the software at regular intervals. In this manner, we hope to control the quality and usability of the software while retaining community involvement in its evolution.

3   Conclusion

If software is a vital component of space syntax research, then its politics are as important as its features. Proprietary academic software is a contradiction; transparency is essential if we are to engage in peer review and build upon each other's work. We believe that open source, which both protects and encourages contributions, is the best policy. Therefore, we offer Syntax2D, an open source platform for space syntax analysis, as the first step in this direction. We hope that other programs and researchers will join us in supporting this effort.

Notes

[1]Axial maps are somewhat limited in this version. Once we have them optimized, we will have the full suite of axial tools in the next version.

[2]Currently, modifications to the source code require Microsoft Visual Studio, which is not freely available. The decision to use Microsoft libraries was made to speed development time of the first version. We hope to eliminate this dependency in the future.

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