# The Image of the City: From the Medial Axes to the Axial Lines

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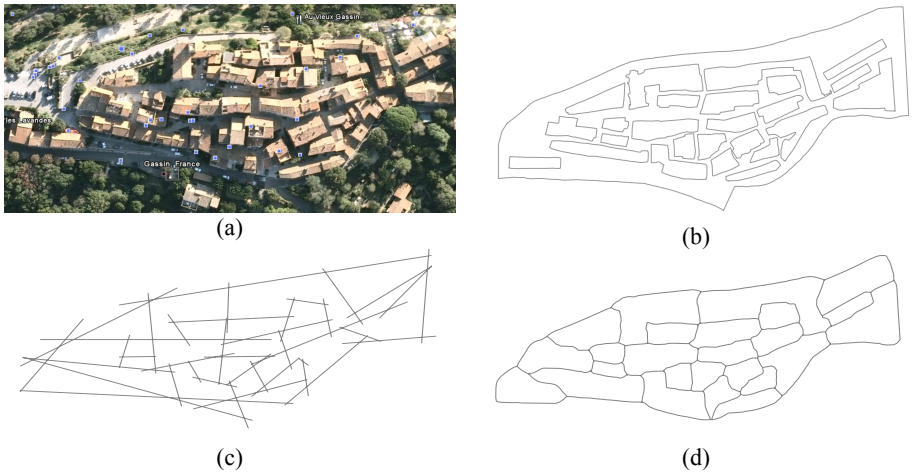
The aim of this poster is two-fold. On the one hand, we try to demonstrate that the axial lines constitute a true skeleton, compared to the medial axes, in capturing a hierarchical structure of open space of any urban environment, being the image of the city. On the other hand, we will demonstrate our research prototype AxialGen (www2.hig.se/~bjg/AxialGen/) in order to show how the axial lines can be automatically generated for exploring the image of the city.

Underlying Kevin Lynch's findings about the image of the city (Lynch 1960) is two novel concepts: city legibility and city imageability. City legibility refers to the ease with which people understand the layout of a city. All city objects such as buildings, streets, places, and squares (or whatever parts/units within a city) (Figure 1a) demonstrate a hierarchical structure. That is, a majority of city objects can be filtered out, while only a minority of them is kept in our minds. Imageability is the quality of a physical object that gives an observer a strong, vivid image. The level of city legibility depends on the existence of imageable elements, and on their spatial configuration, i.e., the legibility comes from the imageability – a quality of the physical urban environment.

We will illustrate and demonstrate that a city can also be perceived from another perspective by concentrating in open space of the city, i.e., the space between buildings or street blocks (Figure 1b). Interestingly, the parts or units of open space also demonstrate a hierarchical structure, which will be shown below (Figure 2). We will further demonstrate that it is the axial lines rather than the medial axes that capture the parts or units of open space. Axial lines are defined as the longest visibility lines covering entirely open space of an urban environment. The least number of the axial lines constitute what is often called axial map (Figure 1c). The axial map, a key space syntax representation (Hillier and Hanson 1984, Hillier 1996), is a de fact skeleton representation of urban environments. Medial axis is a method for representing the shape of an object by the topological skeleton, a set of curves that run along the middle of the object (Blum 1967, Blum and Nagel 1978). We simply refer it to as the set of curves (Figure 1d), hence medial axes in plural form. We will provide strong statistical evidence that characterizes the major difference between the medial axes and the axial lines.

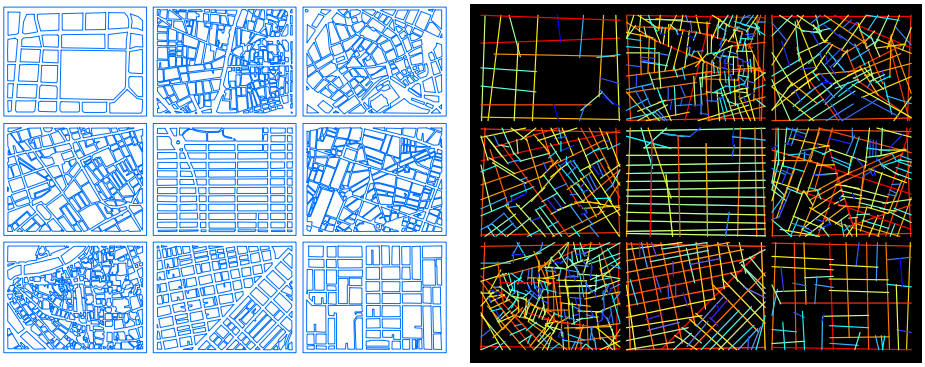
We experimented on a set of typical street patterns (Figure 2a), and found a major statistical difference between the medial axes and the axial lines, both generated by AxialGen (Jiang and Liu 2009b). Taking the case of Paris for example, its medial axes all have a similar length, exhibiting a Gaussian like distribution, whereas its axial lines bear a power law like or heavy tail distribution (Figure 3). The axial map captures the parts we can conceive or what we truly perceive, being the image of the city (Jiang and Liu 2009a). With the axial map, a few longest lines, which are visually dominating, constitute the landmarks that can be distinguished from all other axial lines. This image of the city can further be seen from the axial maps visualized (Figure 2b) according to local integration, one of the key space syntax metrics (e.g., Hillier and Hanson 1984, Jiang 2006, Jiang 2007), with red representing the most integrated lines, and blue the most segregated ones. The reader can assess visually how the kind of hierarchical structure appears with different urban environments. Based on the visualized axial maps, we can further assess city legibility of the street patterns. For example, Paris and London are more legible than Mississauga and New York, because axial lines in Paris and London in terms of length are more diverse than those in Mississauga and New York.




(a) (b)

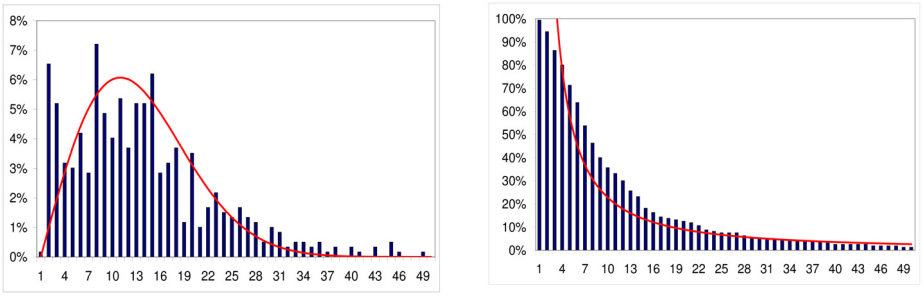
(c) (d)

***Figure 1:*** Illustration of (a) Gassin town image captured from Google Earth, (b) the open space, (c) the medial axes, and (d) the axial lines.



(a) (b)

***Figure 2:*** (Color online) Illustration of the hierarchical structure – the image of the city: (a) typical street patterns (in the reading order): Mississauga, Barcelona, Copenhagen, London, New York, Paris, Rome, San Francisco, and Toronto, (b) axial maps visualized according to local integration for showing underlying hierarchical structure of the street patterns.




(a) (b)

***Figure 3:*** A major statistical difference between the medial axes and the axial lines: (a) Non-hierarchical structure with the medial axes whose length exhibits a Gaussian like distribution, and (b) Hierarchical structure with the axial lines whose length demonstrate a power law like or heavy tail distribution.

**Acknowledgement**
The author thanks Itzhak Omer for his insightful comments to the work.

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