Re-examining the Topological Pattern of Urban Street Networks Using the Maximum Likelihood Estimation (Poster)

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Our previous study illustrated an interesting topological pattern of urban street networks. This topological pattern can be described by the 80/20 principle, i.e., 80% of streets are classified as less connected or shorter length (below the average), while 20% of streets are well connected or longer length (above the average); out of the 20%, there is 1% of streets that are extremely well connected or longer length, which tend to be well known by most of the city residents, and can be found in our mental maps (Jiang 2007; 2008).

This topological pattern is found to be universal as it is applicable to a variety of US cities, as well as some European and Asian cities. The 80/20 principle has another name, so called power law distribution. Therefore, to detect the topological pattern is no more than to detect a power law distribution of both street connectivity and street length. Even though the geometric property of street length is involved, it is from a topological perspective in essence. The previous study adopts a linear regression method, which has been observed to generate errors or inaccuracy (e.g., Goldstein, Morris and Yen 2004; Newman 2005; Sims, Righton and Pitchfford 2007). Based on the observation, a new method based on Maximum Likelihood Estimation (MLE) is suggested to replace the linear regression based method (Clauset, Shalizi and Newman 2007).

This current study is intended to re-examine the topological pattern to see whether or not it remains true using the new method. Based on a MLE and Kolmogorov-Smironv (KS) statistics, this new method aims not only to fit a power law to data, but also to assess how good the fit is, in comparison with other heavy tailed distributions.

Both street connectivity and street length are re-examined based on the new method for their power law fit. It is important to point out that streets are self-organized natural streets (Jiang, Yin and Zhao 2008), which are generated from individual street segments by three different join principles: every- best-fit, self-best fit, and self-fit.

The current study adopts the three join principles, in order to get insight deep into the topological pattern. While the conclusion about the 80/20 principle remains unaffected, there are some adjustments about power law fits and the computed power law exponents. For instance, we found that most street networks follow power law with an exponent cutoff rather than the power law distributions in a strict sense. For a few exceptions, neither power law nor power law with a cutoff is evident in the statistical tests. However, they still belong to some heavy tail distributions. The estimation of power exponents remains unchanged.

Bipartite power law distributions are better expressed by a power law with cutoff (the falling part as an exponential cutoff). In addition, we further found that the threshold angle and different join principles have no much effect on the topological pattern and power law exponents.