Improving transport dynamics through analysis of selected transportation networks

Rajarshi Basak, 15th October, 2018

A network consisting of junctions/intersections connected by roads/lanes or highways in any major city is pivotal to movement of people and transportation of goods between two or more points where movement by foot is not an option.

'Transportation Networks' (link at https://github.com/bstabler/TransportationNetworks) is a repository of datasets which have networks representing a city where each network consists of nodes representing an intersection in the city or the metropolitan area, and edges representing traffic flow. Each graph is directed and unweighted, and has a metadata file.

The metadata for each network has a directional link on each line, pointing from the direction of the initial node (the starting intersection) to the terminal node (the ending intersection), a travel time for the link, a generalized cost for traveling along the link, the capacity, the length, the free flow time, the speed limit and the toll for the link.

In an effort to improve traffic flow between intersections and optimize travel times along routes, the intention of the project is to analyze these networks considering the edgelist and metadata files, and evaluating parameters of interest in the network - which include computing different centrality values of each node(intersection) in a network (to reveal the importance of each intersection in the city), detecting communities (of intersections) from the point of view of attributes of the network like travel time, cost of travel and toll (by investigating their assortativity values) among others.

One of the goals of the project would be to conduct a comparative study of roads and intersections for all the cities/metropolitan areas and pinpoint the strengths and shortcomings of each of these networks. The other objective would be to look at some models and algorithms for road network design, and see if it is possible to come up with better networks for each of the cities/metrpolitan areas.

Some of the long term objectives include suggesting improvements or changes in the network (transportation network in the city) such as reducing the toll between between two intersections to allow more traffic/flow, creating more intersections to ease bottlenecks between existing intersections, increasing the number of lanes to increase capacity and reduce travel time along a lane, etc.

We also intend to explore these networks using random-graphs (with specified degree distributions and/or specified degree sequences) to explore properties like the network diameter, clustering coefficient and reciprocity, and the emergence of giant components, if any. Random graphs also help us build a better network given just the nodes, in terms of optimizing certain parameters of interest.

An alternative : Conduct a similar study with air transportation networks in US (or the entire planet, depending on availability of data) instead of road networks. By coupling it with census population data, try to predict the outbreak of global epidemics [5].

References

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