Visualise Shrinking and Wrinkling of Space Caused by Uneven Regional Accessibility Development Using Time-Space Map

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Abstract

Investing on road network improves accessibility of a region generally, although levels of improvement vary between individual cities. Time-space map, which reproduces geographic space by redefining proximities using travel-miles or travel-time on shortest-paths between cities, has been seen as an adequate visual summary of the travel time relationships in a given environment and relevant techniques has being discussed since 1960s. However, current time-space analysis method is still underdeveloped because of: (1) short of data (making time-space map of N cities needs an OD data matrix of N*(N-1)/2 records); (2) uncertain the fitness of a result (errors are unavoidable, but how big the error is?). Recent developments on web-based-map-service and data-crawling technique have made generating OD data matrix of hundreds cities possible, using online geo-data resource. Meanwhile GIS visualisation module is now able to present time-space map properly 2D or 3D. These new developments now allow the potential of bringing time-space analysis techniques to another level.

This poster developed and tested an analytical method for using time-space map to visualize regional transportation accessibility pattern, based on a synergy of current internet big data capturing, statistic analysing, and 3D-visualization technologies. Firstly, OD data matrix (travel distance and travel time by cities) is generated from major web-map-server's direction API using web-crawling programs. Secondly, Multidimensional-Scaling method is applied to find the best-fitting configuration space while replacing Euclidean distance with network distance or time distance collected. The range and distribution of errors are further examined to test the validity and reliability of the result. Finally, configuration space is overlapped with the geographical map in 3D environment, to observe the stretching, shrinking and wrinkling effects of space caused by uneven transportation accessibility improvement.

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