

Detecting the urban traffic network structure dynamics through the growth and analysis of multi-layer networks

ABSTRACT

Research into multi-layer network growth in the detection of urban dynamics provides scholars a new way to discuss the structure changing trends and related impacts. The quantitative research method is applied to examine, the network centrality, network accessibility and network community partition focusing on the upper-layer (rail network) network growth process. We based on the case study of Kuala Lumpur and found that when a rail network grows with a simple tree-like network to a more intricate form, the network diameter and the average shortest path length of multi-layer networks decrease dramatically. The network expansion ability keeps changing and more rail stations in the city centre have higher ability for future expansion. Changes in betweenness centrality and closeness centrality of multi-layer networks essentially hinge on the growth of rail network, with the highest change rate of closeness centrality at around 211.48%. The growth of network allows the remainder of the network to be easily visited, with the highest change rate of network accessibility around 12%. Different performances of these nodes added in the multi-layer network are discussed to show their impact on the repartition of network communities and the number of communities is decreasing. We believe this research can benefit scholars to easily understand and apply these network dynamic computational techniques.

Keyword: Complex network; Multi-layer network growth; Traffic network accessibility; Network centrality; Community partition; Urban structure dynamics
