A Topological Road Map of Newcastle upon Tyne

Jon Swords and Bruce Carlisle, Department of Geography, Northumbria University, UK.

This featured graphic is a topological road map of Newcastle upon Tyne, UK, generated using GIS and social network analysis software using Ordnance Survey data. The map formed part of 'en_counter' (2016), an exhibition of mapping work in Newcastle upon tyne.

The map is derived from Ordnance Survey MasterMap Integrated Transport Network data (Ordnance Survey, 2010), provided in a multi-part fully topologically structured link and node format including information about roads ('RoadLink'), their names ('Road') and their connections ('RoadNode'). Various data manipulations were made using ArcMap GIS and spreadsheet software to transform the data into the flat file format needed by Gephi social network analysis software. Relevant attributes from the 'RoadNode' and 'Road' items were joined to the 'RoadLink' features. The 'RoadLink' features were clipped to the boundary of Newcastle Metropolitan District using Ordnance Survey Boundary-Line data (Ordnance Survey, 2015). Only public roads were selected and so excluding alleys and private roads. Some 'RoadLinks', mainly segments of roundabouts and slip roads, had no name. A name was added if appropriate, or else the link was deleted. Incidences of the same name being used for different roads were identified and the name was altered to, for example, High Street 1, High Street 2, etc. A series of look-up operations, sorts and filters were used to produce a flat table with each row representing a named road and one of the roads it connects with. The result was data in which connections between roads are maintained, but their location is free to be manipulated.

Gephi allows the manipulation and analysis of social network graphs. We used the Force Atlas 2 algorithm (Jacomy et al., 2014) to generate forces of attraction and repulsion within the network, pulling together nodes (in this case roads) which share connections, and pushing part those which don't. Refinement of labels, lines and layout was done in Adobe Illustrator.

The final map is accurate in the sense it can be used to navigate the city from road to road, but the lack of geospatial references make it unfamiliar and discombobulating upon viewing. Suburbs and coherent urban areas are grouped together and are located in relation to one another which is logical,

but strange at the same time. Topographical scale is lost as map distance is a result of relational connectivity rather than points in physical space.

An approach similar to this has been previously theorized (Park and Yilmaz, 2010), albeit without spatialising algorithms in mind. Statistical analysis of the network can be undertaken including measures of centrality to identify significant roads based on the number of connections. The ever-busy B1600 (Osborne Road-Portland Road-Stoddard Street) has the highest Eigenvector centrality score [1]and the A1 ring road the highest betweenness centrality. On average each road in the city is connected to three other nodes.

References

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1] Eigenvector centrality measures the centrality of a node taking takes into account the centrality of neighbouring nodes with which it is connected (. Scores are relative, the most important node = 1. (ref). Betweenness centrality measures how often a node appears on paths between nodes in the network. That is, it measures how often a particular node is crossed when tracing the shortest pathway between any two nodes (Scott, 2000)