

Vulnerability analysis of weighted graphs: a measure of vulnerability of spatial network by using betweenness centrality

Zhe Zhang^{*}, Aalto University, Espoo, Finland, zhe.zhang@aalto.fi

Kirsi Virrantaus, Aalto University, Espoo, Finland, kirsi.virrantaus@aalto.fi

The infrastructure of critical networks is important for human life. Vulnerability analysis of critical networks has often been discussed in the literature because of the increasing numbers of natural and man-made hazards and disasters. Betweenness is one of the topological centrality measure methods in the field of graph analysis. It has been used to identify the critical location for an un-weighted spatial network, where it is assumed that the length of each graph segment is the same and the shortest path for each pair of locations (vertex) is the path which contains the fewest locations (vertices). In reality, the shortest path between two locations in a spatial network should have shortest length; therefore betweenness analysis should be applied to a weighted graph, where weight refers to the length of each graph segment. In this article, a betweenness centrality measure was applied to three weighted graphs (transportation, drinking water and natural gas networks) to measure the importance of a graph segment according to its topological location. This research work is part of the “Critical Infrastructure Protection (Matine)” project. The goal of the project is to analyse the vulnerability of the critical networks of the city of Tampere for crisis management purposes.

Key Words: critical networks, betweenness centrality, graph analysis, crisis management