Determining Network Robustness Using Region Based Connectivity

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In today's increasingly interconnected world, robust networks are crucial for military or civilian activities. The ability to test a network's resiliency is important, whether it is a communications, roadways, power lines etc. network. In the past, node and edge connectivity were used to gauge a network's reliability, but they do not consider the locality of failures. In the real world, entire regions, not simply random nodes, are affected (like in natural or man made disasters). The purpose of my work is to test the robustness of networks using the metric of Region Based Connectivity. My tool is given a network's information such as its coordinates, connectivity information, and a 'radius of disruption' for each node. Any edge or node lying within the region of disruption of a node 'n' is deemed to fail if node 'n' fails. Region disjoint paths are paths that do not pass through the same regions. My work tests to see if there exist at least 'k' region disjoint paths between a given start and end node pair. The results from my analysis of the Houston highway system and the Level 3 Communications network in Southern England demonstrate how effective my tool is. Although it seems as though the Houston highway network may enable effective evacuation routes in case of hurricanes, these routes tend to pass through the same regions. This causes congestion in that if a region is flooded many routes are affected. These problems were apparent during Hurricanes Rita and Katrina, which confirm my results. Similarly, the Level 3 Communications network analysis identifies vulnerable cities, which could disrupt London's communication with the world. In conclusion, this new paradigm is important in testing the resilience of sensitive networks.

Awards Won:

National Security Agency Research Directorate : Third Award of $1,000

Oracle Academy: Award of $5,000 for outstanding project in the systems software category.

European Organization for Nuclear Research-CERN: Second Award of $1,500

Third Award of $1,000