# FLOW OPTIMIZATION IN COMPLEX NETWORKS

By

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Transport and flow on complex network have attracted lots of attention because of their extensive applications to biological, transportation, communication and infrastructure networks. Recently, simple resistor networks were utilized to study transport efficiency in scale-free and small-world networks.

In this Master Thesis, we investigate and characterize the statistics of the extremes in correlated load landscapes in the complex networks. Four network models: scale-free network, Erdős-Rényi random graph, random geometric graph and small-world network, are utilized here. Each of them could mimic certain properties of real-world networks. We consider a specific form of the weights, where the strength of a link is proportional to $(k_i k_j)^\beta$ with $k_i$ and $k_j$ being the degrees of the nodes connected by the link. We also add parameter $\rho$ to control the probability for each node to become either the source or target. Exact numerical diagonalization based method and computational codes (for weighted network Laplacians) are employed to extract flow-based load. Mainly, we focus on two important observables, the maximal current flow and the average current flow in the network. Numerical results show that the optimal value of $\beta$ for the maximum current flow is close to $-1$ for homogenous source/target rate. Further, this optimal value can change for different $\rho$ depending on the network topology. Those results could help understand the network vulnerability problem and thus further the future work on cascading network failures.