

Improving robustness of complex networks via the effective graph resistance

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Definition and Motivation

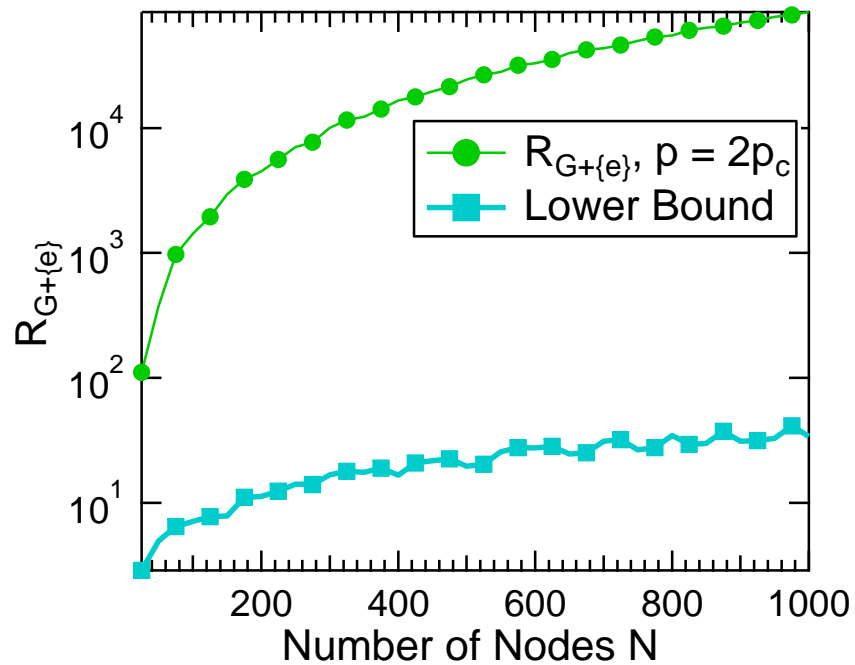
- Motivation: robustness of networks
- Robustness metric: effective graph resistance

$$R_G = N \sum_{k=1}^{N-1} \frac{1}{\mu_k}$$

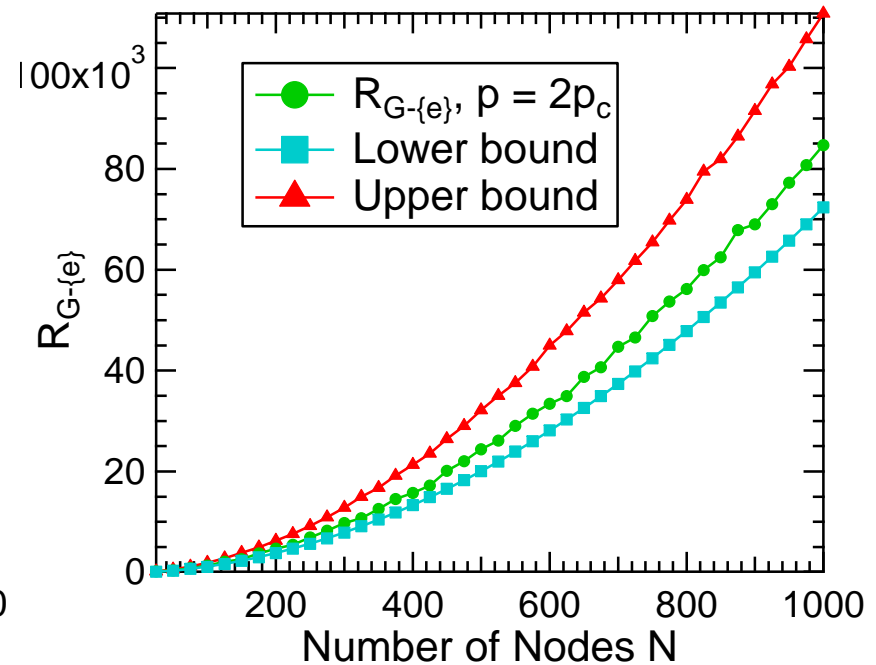
- Research question
 - Which single link can be added to maximally decrease effective graph resistance in a given network?
 - Protecting a link whose removal maximally increases the effective graph resistance

Theoretical Bounds

Erdős Rényi Graph



Link addition



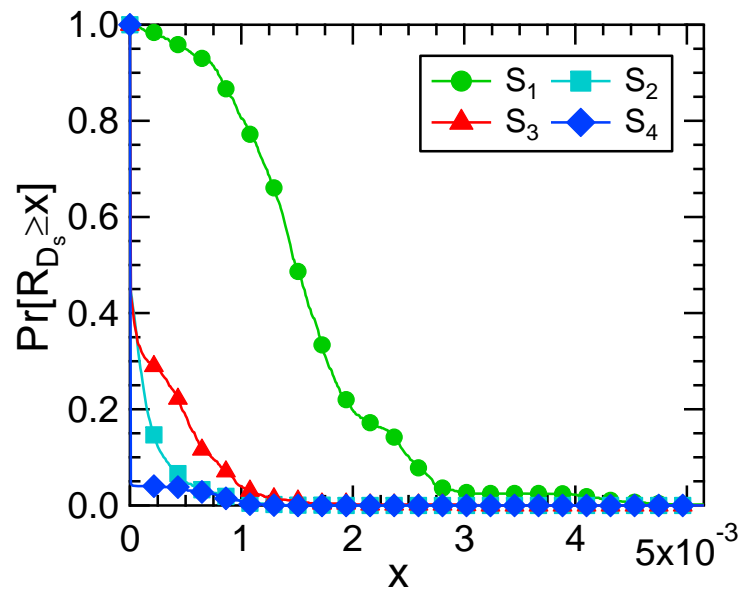
Link removal

Link Selection and Evaluation

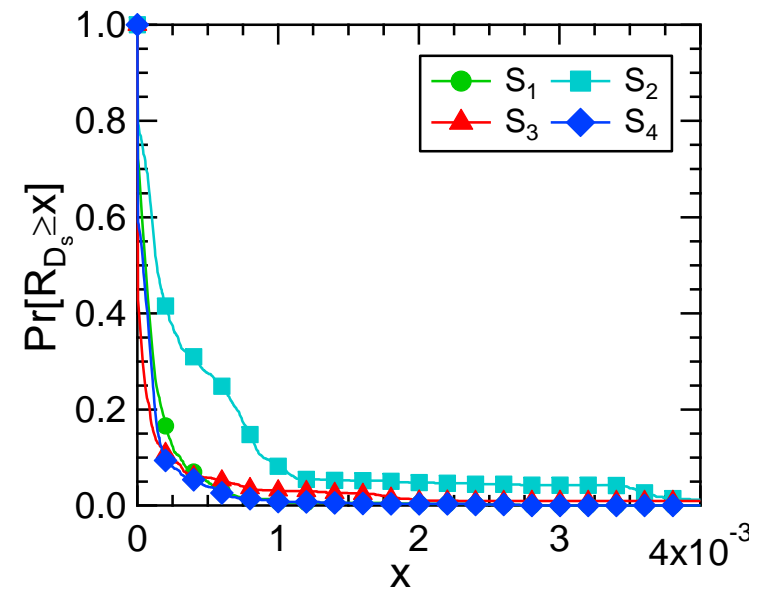
- 4 strategies for link addition/ removal:
 - S1: random
 - S2: degree based
 - S3: Laplacian spectrum based
 - S4: Effective resistance based
- Compare 4 strategies with exhaustive search
- Synthetic and real-world networks

Results

Erdős Rényi Graph

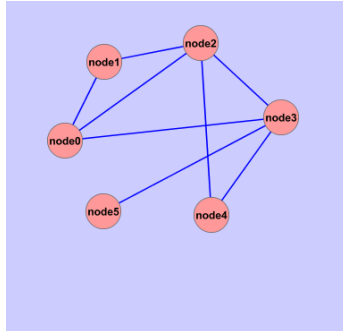


Link addition

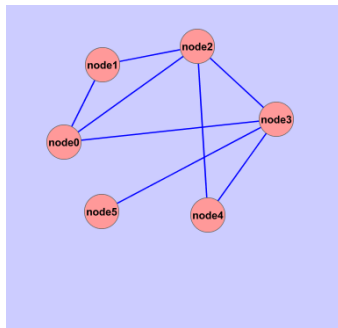
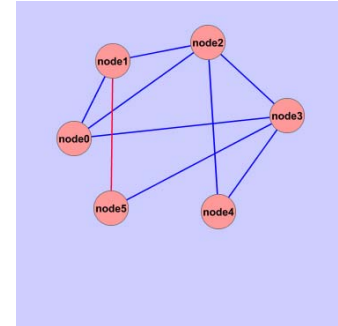


Link removal

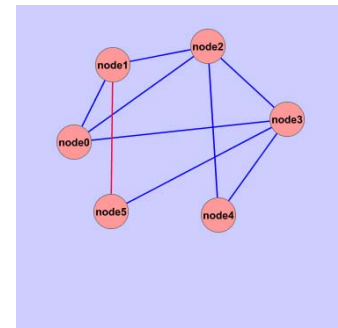
Algebraic Connectivity VS Graph Resistance



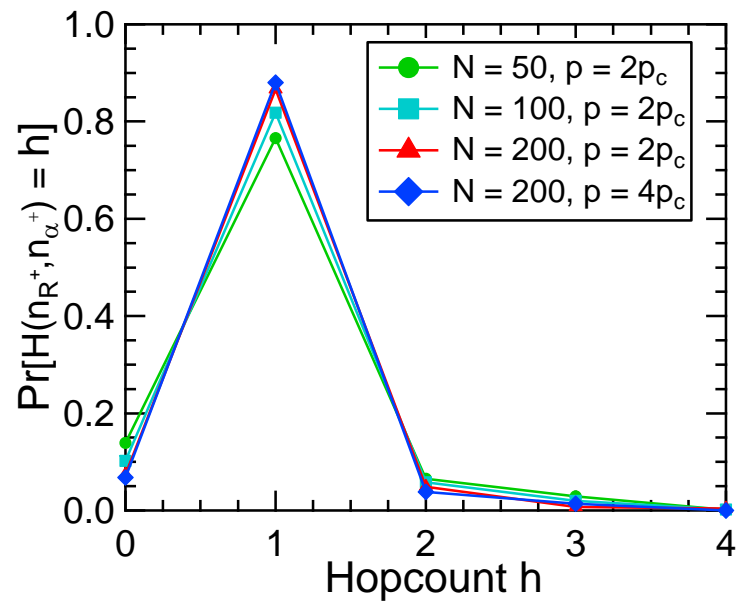
Add a link to
optimize
algebraic
connectivity



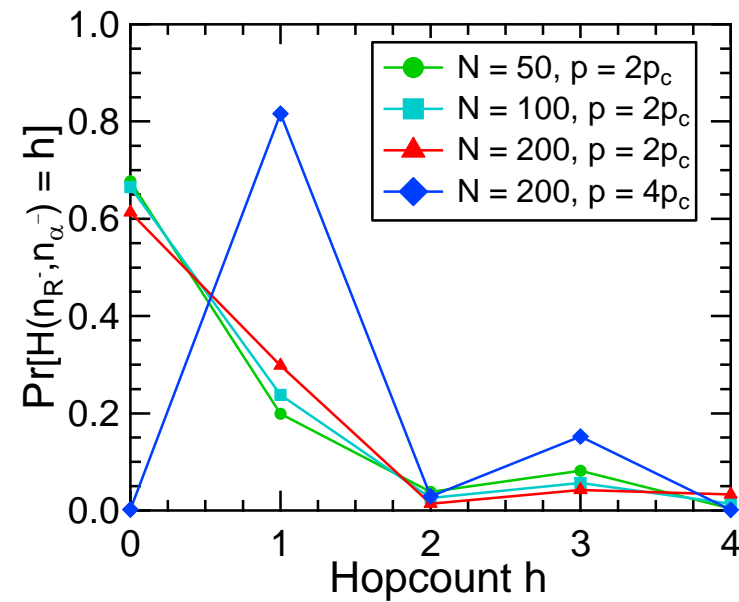
Add a link to
optimize graph
resistance



Algebraic Connectivity VS Graph Resistance



Link addition



Link removal

