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Scaling of Minimum Dominating Sets in Various Scale-Free Network Ensembles[1] F. MOLNAR, S. SREENIVASAN, B.K. SZYMANSKI, G. KORNISS, Rensselaer Polytechnic Institute — We study the scaling behavior of the size of minimum dominating sets (MDS) in scale-free networks, with respect to network size N and power-law exponent γ [Nacher et al., NJP 073005 (2012)]. Network samples are constructed by either the configuration model (CM) via multigraphs, or exact degree sequence sampling methods. The MDS is found by a sequential greedy algorithm. We control the average degree by setting an appropriate lower degree cutoff $k_{\min}$. Two subtypes of networks are studied according to the maximum degree cutoff $k_{\max}$. Our results show that when $k_{\max} = \sqrt{N}$ all networks have similar scaling. The size of MDS is linear with respect to N, and for a given N, it increases for low γ values. When $k_{\max} = N - 1$, we find a structural difference between CM networks, and networks constructed by exact sampling methods. For the latter, we find a scaling transition of the MDS size from O(N) to O(1) at approximately $\gamma \approx 1.9$, due to the appearance of star subgraphs with O(N) central degree. For a given N, the size of MDS increases for higher γ values. However, in CM networks the MDS scales linearly with N, and for a given N, it is non-monotonic with respect to γ. Finally, we find that a partial MDS, which dominates only a certain fraction of the network, has the same scaling as full domination, even for as low as 30% dominated fraction.

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Ferenc Molnar
Rensselaer Polytechnic Institute

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