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Effect of Disorder Strength on Optimal Paths in Complex Networks SAMEET SREENIVASAN, Center for Polymer Studies and Department of Physics, Boston University, Boston, MA 02215, USA , TOMER KALISKY, Minerva Center and Department of Physics Bar-Ilan University, 52900 Ramat-Gan, Israel, LIDIA A. BRAUNSTEIN, Departamento de Física, Facultad de Ciencias Exactas y Naturales Universidad Nacional de Mar del PlataFunes 3350, 7600 Mar del Plata, Argentina , SERGEY V. BULDYREV, 40 Laurel Hill Terrace, Belfer Hall, Yeshiva U, NY NY , SHLOMO HAVLIN, Minerva Center and Department of Physics Bar-Ilan University, 52900 Ramat-Gan, Israel, H. EUGENE STANLEY, Center for Polymer Studies and Department of Physics,Boston University, Boston, MA 02215, USA — We study the transition between the strong and weak disorder regimes in the scaling properties of the average optimal path $\ell_{\rm opt}$ in a disordered ER random network and SF network. We find that for any finite value of the disorder strength control parameter a, there is a crossover network size $N^*(a)$ at which the transition occurs. For $N \ll N^*(a)$ the scaling behavior of $\ell_{\rm opt}$ is in the strong disorder regime, with $\ell_{\rm opt} \sim N^{1/3}$ for ER networks and for SF networks with $\lambda \geq 4$, and $\ell_{\rm opt} \sim N^{(\lambda-3)/(\lambda-1)}$ for SF networks with $3 < \lambda < 4$. For $N \gg N^*(a)$ the scaling behavior is in the weak disorder regime, with $\ell_{\rm opt} \sim \ln N$ for ER networks and SF networks with $\lambda > 3$. We proceed to derive the scaling relation between $N^*(a)$ and a. We find that $N^*(a) \sim a^3$ for ER networks and for SF networks with $\lambda \geq 4$, and $N^*(a) \sim a^{(\lambda-1)/(\lambda-3)}$ for SF networks with $3 < \lambda < 4$.

Sameet Sreenivasan
Center for Polymer Studies and Department of PhysicsBoston University, Boston, MA 02215, USA,

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