Distances in random networks - recent results

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The theory of complex networks provides a useful conceptual framework for the study of a large variety of systems and processes in science, technology and society. These studies are based on network models, in which the nodes represent physical or virtual objects, while the edges represent the interactions between them. Typically, these networks exhibit random structures, which can be characterized by their statistical properties at the local and global scales. The local structure of a network is captured by the degree distribution and by certain correlations between nearby nodes. The large scale structure is captured by the spectrum of path lengths between random pairs of nodes. The shortest path between each pair of nodes is of particular importance because it provides the strongest interaction and fastest response between these nodes. While the average distance has been studied extensively, the analytical calculation of the entire distribution has received much less attention. In this presentation I will describe a a novel suite of analytical approaches for the calculation of the DSPL in a wide range of random networks both in and out of equilibrium, including Erdos-Renyi networks, random regular graphs and more generally, configuration model networks, as well as node-duplication networks. The results are found to be in agreement with numerical simulations for a broad range of networks, sizes and connectivities.

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