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Maximum matchings in scale-free networks with identical degree distribution

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Abstract

The size and number of maximum matchings in a network have found a large variety of applications in many fields. As a ubiquitous property of diverse real systems, power-law degree distribution was shown to have a profound influence on size of maximum matchings in scale-free networks, where the size of maximum matchings is small and a perfect matching often does not exist. In this paper, we study analytically the maximum matchings in two scale-free networks with identical degree sequence, and show that the first network has no perfect matchings, while the second one has many. For the first network, we determine explicitly the size of maximum matchings, and provide an exact recursive solution for the number of maximum matchings. For the second one, we design an orientation and prove that it is Pfaffian, based on which we derive a closed-form expression for the number of perfect matchings. Moreover, we demonstrate that the entropy for perfect matchings is equal to that corresponding to the extended Sierpiński graph with the same average degree as both studied scale-free networks. Our results indicate that power-law degree distribution alone is not sufficient to characterize the size and number of maximum matchings in scale-free networks.

Keywords: Maximum matching, Perfect matching, Pfaffian orientation, Scale-free network, Complex network

1. Introduction

A matching in a graph with N vertices is a set of edges, where no two edges are incident to a common vertex. A maximum matching is a matching

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