Monte Carlo Algorithms for Identifying Densely Connected Subgraphs

Jingfei Zhang\(^1\), Yuguo Chen\(^2,^*\)

1. University of Miami
2. University of Illinois at Urbana-Champaign

\(^*\)Contact author: yuguo@illinois.edu

**Keywords:** Densest subgraph discovery, Global optimization, Network, Quasi-clique, Simulated annealing

The problem of finding densely connected subgraphs in a network has attracted a lot of recent interest. Such subgraphs are sometimes referred to as communities in social networks or molecular modules in protein networks. In this article, we propose two Monte Carlo optimization algorithms for identifying the densest subgraphs with a fixed size or with size in a given range. The new algorithms combine the idea of simulated annealing and efficient moves for the Markov chain, and both algorithms are shown to converge to the set of optimal states (densest subgraphs) with probability one. When applied to a yeast protein interaction network and a stock market graph, the algorithms identify interesting new densely connected subgraphs.