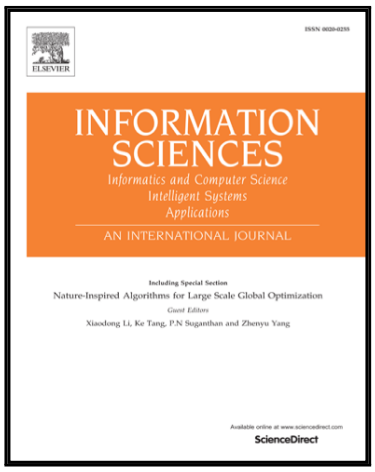

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PII: S0020-0255(16)30447-9
DOI: 10.1016/j.ins.2016.06.025
Reference: INS 12299

To appear in: *Information Sciences*

Received date: 2 April 2015
Revised date: 8 June 2016
Accepted date: 17 June 2016

Please cite this article as: Debao Chen , Feng Zou , Renquan Lu , Lei Yu , Zheng Li , Jiangtao Wang , Multi-objective optimization of community detection using discrete teaching–learning-based optimization with decomposition, *Information Sciences* (2016), doi: 10.1016/j.ins.2016.06.025

Multi-objective optimization of community detection using discrete teaching–learning-based optimization with decomposition

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Abstract—Community detection has been an active field of study in complex network analysis in recent years. It can be modeled as a seriously nonlinear optimization problem. Many intelligent optimization techniques have shown promising results for this problem. The teaching–learning-based optimization (TLBO) algorithm is a recently proposed swarm intelligent algorithm. In this paper, a discrete variant of TLBO (DTLBO) is proposed to address discrete optimization problems. In the proposed method, the learner representation scheme is redefined, and the updating rules for learners are also redesigned. Moreover, based on the proposed discrete variant DTLBO, a multi-objective discrete method (MODTLBO/D) is proposed to solve community detection problems for complex networks. The multi-objective decomposition mechanism is adopted and neighbor-based mutation is introduced to maintain the diversity of the population and avoid being trapped in the local optima. Finally, to verify the performance of the proposed algorithm, real-world networks are examined. The experimental results indicate that MODTLBO/D is effective compared with other algorithms used for community detection in complex networks.

Keyword: Community detection; Discrete optimization; Teaching–learning-based optimization; Multi-objective optimization; Decomposition.

1. Introduction

Real-world networks involve many important and complex interactions among individuals [3], for example, social networks [46], biological networks [6], biochemical networks [13], and communication networks [22]. These networks can be naturally represented as complex networks. In mathematics and computer science, complex networks are often modeled as graphs. More specifically, a complex network consists of nodes (or vertices) and edges (or links), which represent the individual members and their relationships. Generally, the cluster or community is defined as a subset of vertices that are closely knit in a relatively sparse neighborhood. Hence, the cluster or community is composed of individuals with common properties inherent to complex networks [48]. Community detection or network clustering is essential in complex networks; it is one of the most relevant features of networks