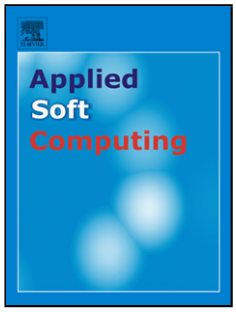

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Artifical Bee Colony Algorithm using Problem-Specific Neighborhood Strategies for the Tree t-Spanner Problem

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Abstract

A tree t-spanner is a spanning tree T in which the ratio of distance between every pair of vertices is at most t times their shortest distance in a connected graph, where t is a value called stretch factor of T. On a given connected, undirected, and weighted graph, this paper studies the tree t-spanner problem (Tree_t-SP) that aims to find a spanning tree whose stretch factor is minimum amongst all spanning trees of the graph. Being a $\mathscr{NP}$-Hard for any fixed $t > 1$, this problem is under-studied in the domain of metaheuristic techniques. In literature, only genetic algorithm has been proposed for this problem. This paper presents an artificial bee colony (ABC) algorithm for this problem, where ABC algorithm is a swarm intelligence technique inspired by intelligent foraging behavior of honey bees. Neighborhood strategies of ABC algorithm particularly employ problem-specific knowledge that makes ABC algorithm highly effective in searching high quality solutions in less computational time. Computational experiments on a large set of randomly generated graph instances exhibit superior performance of ABC algorithm over the existing genetic algorithm for the Tree_t-SP.

Key words: Tree Spanner, Weighted Graph, Problem-Specific Knowledge, Swarm Intelligence, Artificial Bee Colony Algorithm

1. Introduction

Given a connected graph G, a spanning tree T is called a tree t-spanner if the distance between every pair of vertices, say x and y in T is at most t times their shortest distance in G. t is a value called the *stretch factor* of T. The *stretch factor* is the maximum *stretch* taken over all pairs of vertices in G, where the *stretch* of a pair of vertices x and y in T is the ratio of the distance between x and y in T to their shortest distance in G. The *tree t-spanner problem* seeks to find a spanning tree in G whose *stretch factor* (t) is minimum amongst all spanning trees in G.

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