Accepted Manuscript

Title: Artificial Bee Colony Algorithm using Problem-Specific Neighborhood Strategies for the Tree $t$-Spanner Problem

Author: Kavita Singh Shyam Sundar

PII: S1568-4946(17)30627-0
DOI: https://doi.org/doi:10.1016/j.asoc.2017.10.022
Reference: ASOC 4517


Received date: 4-4-2017
Revised date: 21-8-2017
Accepted date: 9-10-2017

Please cite this article as: Kavita Singh, Shyam Sundar, Artificial Bee Colony Algorithm using Problem-Specific Neighborhood Strategies for the Tree $t$-Spanner Problem, <CDATA[Applied Soft Computing Journal]> (2017), https://doi.org/10.1016/j.asoc.2017.10.022

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Artifical Bee Colony Algorithm using Problem-Specific Neighborhood Strategies for the Tree $t$-Spanner Problem

Kavita Singh, Shyam Sundar*

Department of Computer Applications, National Institute of Technology Raipur
Raipur 492010, India

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 $\mathcal{NP}$-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 $G$.

*Corresponding author

Email addresses: ksingh.phd2015.mca@nitrr.ac.in (Kavita Singh), ssundar.mca@nitrr.ac.in (Shyam Sundar)