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Master-Slave TLBO Algorithm for Constrained Global Optimization Problems

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Abstract

INTRODUCTION: The teaching-learning based optimization (TLBO) algorithm is a recently developed algorithm. The proposed work presents a design of a master-slave TLBO algorithm.
OBJECTIVES: This research aims to design a master-slave TLBO algorithm to improve its performance and system utilization for CEC2006 single-objective benchmark functions.
METHODS: The proposed approach implemented using OpenMP and CUDA C, a hybrid programming approach to enhance the utilization of the system's computational resources. The device utilization and performance of the proposed approach evaluated using CEC2006 benchmark functions.
RESULTS: The proposed approach obtains best results in significantly reduced time for CEC2006 benchmark functions. The maximum speed-up achieved is 30.14X. The average GPGPU utilization is 90% and the average utilization of logical processors is more than 90%.
CONCLUSION: The master-slave TLBO algorithm improves the utilization of computational resources significantly and obtains the best results for CEC2006 benchmark functions.

Keywords: Master-slave TLBO algorithm, Parallel Evolutionary Algorithms, GPGPU, Constrained benchmark functions, Optimization problems.

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1. Introduction

Optimization is defined as "Finding an alternative with the most cost effective or highest achievable performance, by maximizing desired factors and minimizing undesired ones" [1]. Optimization functions are discrete/continuous and constrained/unconstrained types. The optimization problems found in engineering and other domains are constrained and unconstrained in nature. The constrained optimization problems are optimized concerning certain restrictions. The restrictions exist on different things like resources availability, time, etc. The unconstrained optimization problems are free from such restrictions. These problems are optimized with respect to design variables and their range as well as dimensionality. The constrained and unconstrained optimization problems are of single and multi-objective optimizations [2-5].

In literature, different classical methods used to solve the constrained and unconstrained optimization problems. These methods have their own merits and demerits. Researchers have developed nature-inspired approaches to solving complex engineering design and optimization problems [2]. When an algorithm is proposed newly, validation and efficiency of the algorithm need to be evaluated. Therefore,