METAHEURISTIC ALGORITHMS AND NEURAL NETWORKS IN HYDROLOGY

Edited by
Kuok King Kuok and
Md Rezaur Rahman

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CHAPTER 10

HYBRID SINE COSINE AND FITNESS DEPENDENT OPTIMIZER FOR INCOMPLETE DATASET

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Abstract

The hybrid sine cosine and fitness dependent optimizer (SC-FDO) introduces four modifications to the original fitness dependent optimizer (FDO) algorithm to improve its exploit-explore tradeoff with a faster convergence speed. The modifications include a modified pace-updating equation, a random weight factor and global fitness weight strategy, a conversion parameter strategy, and a best solution-updating strategy. This chapter evaluates the generalization ability of the hybrid SC-FDO based neural network (SC-FDONN) in handling missing data imputation challenges that exhibit different percentages of missingness. The hybrid SC-FDONN's performance was evaluated using hold-out and cross-validation techniques. The findings revealed that the SC-FDONN outperformed all the benchmarks by an average accuracy of 94.3%. Therefore, the hybrid optimizer, SC-FDONN, is an effective

technique for handling different percentages of missing data problems.

Keywords: Sine cosine (SC), fitness dependent optimizer (DO), optimization, missing rainfall data, imputation

1. Introduction

Engineering optimization has become a growing trend for solving complex engineering challenges. Recent research in nature-inspired metaheuristics has produced optimization methods that have demonstrated their superiority in addressing specific challenges, such as Genetic Algorithm (GA) (Holland, 1992), Whale Optimization Algorithm (WOA) (Mirjalili & Lewis, 2016; Louis et al., 2019), Particle Swarm Optimization (PSO) (Kennedy & Eberhart, 1995; Kuok et al., 2007; Kuok, 2010; Kuok et al., 2010), Sine Cosine Algorithm (SCA) (Mirjalili, 2016), Butterfly Optimization Algorithm (BOA) (Arora & Singh, 2019), Cuckoo Search Optimisation (CSO) (Kuok et al., 2021); Salp Swarm Optimisation (SSO) (Teng et al., 2021); Bat (Kuok et al, 2019a; Kuok et al., 2019b), and Fitness Dependent Optimizer (FDO) (Abdullah & Ahmed, 2019). The main challenge for all metaheuristics is to balance the exploration and exploitation ability to obtain optimal solutions efficiently (Kuok et al., 2011).

Several hybrid metaheuristics and advancements in optimization often leverage the strengths of multiple approaches to enhance efficiency and effectiveness. Inspired by this, many researchers have proposed several advancements from different perspectives to improve the original FDO. These include an improved fitness-dependent optimizer (IFDO) algorithm based on alignment and cohesion strategy in a multi-source interconnected power system (Muhammed et al., 2020), an adaptive FDO (AFDO) algorithm applied to one-dimensional bin packing (Abdul-Minaam et al., 2020), chaotic fitness dependent optimizer (CFDO) in task assignment problems (Mohammed & Rashid, 2021), and sine cosine fitness dependent optimizer (SC-FDO) in missing value imputation problems (Chiu et al., 2021a).

The hybrid sine cosine and fitness dependent optimizer (SC-FDO) is a new hybrid approach that combines the strengths of the SCA (Mirjalili, 2016) and FDO (Abdullah & Ahmed, 2019). The FDO is a nature-inspired optimization technique that adjusts the search strategy based on the fitness function of the promising solutions. At the same time, the SCA simulates the movement of sine and cosine trigonometric functions to exploit the best