# METAHEURISTIC ALGORITHMS AND NEURAL NETWORKS IN HYDROLOGY

Edited by
**Kuok King Kuok** and
**Md Rezaur Rahman**

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# CHAPTER 9

# SINE COSINE ALGORITHM BASED NEURAL NETWORK FOR RAINFALL DATA IMPUTATION

PO CHAN CHIU[1], ALI SELAMAT[2], KUOK KING KUOK[3]

[1]Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia.
[2]Malaysia Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia Kuala Lumpur, Jalan Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia.
[3]Faculty of Engineering, Computing and Science, Swinburne University of Technology, Sarawak Campus, Jalan Simpang Tiga, 93400, Kuching, Sarawak, Malaysia.

## Abstract

*The Sine Cosine Algorithm (SCA) is a relatively recent metaheuristic algorithm, drawing inspiration from the characteristics of trigonometric sine and cosine functions. SCA has been widely used to address diverse optimization challenges in several domains. The advantages of SCA can be attributed to its simple implementation, reasonable execution time, and adaptability to hybridize with other optimization methods easily. This chapter presents the ability of the sine cosine algorithm based neural network (SCANN) to predict and optimize missing rainfall at different percentages of missing rates. These findings revealed the superior performance of the SCANN imputation method compared to the feedforward neural network (FFNN) method, indicating its suitability for efficiently filling missing values in the rainfall database.*

**Keywords:** Missing rainfall, Imputation, Sine Cosine Algorithm Based Neural Network (SCANN), feedforward neural network (FFNN)

## 1. Introduction

Over the last three decades, there has been a substantial increase in research attention devoted to nature-inspired metaheuristic algorithms for solving complex and real-world problems in various domains. Many real-world problems involve finding global optima or high-quality solutions, and metaheuristics are particularly adept at addressing such global optimization challenges (Kuok et al., 2019a; Louis et al., 2019; Teng & Kuok, 2021). The innovative solutions and approaches for tackling complex and real-world problems have contributed to advancements in various domains and improved problem-solving capabilities (Kuok et al., 2019b; Kuok et al., 2021). According to Abualigah and Diabat (2021), researchers have paid much attention to the sine cosine algorithm (SCA) because it has a reasonable execution time, a good convergence rate, and is more efficient than several well-known optimization algorithms. The results showed that the SCA is superior to other optimization algorithms, such as the Flower Pollination Algorithm (FPA), Gravitational Search Algorithm (GSA), Firefly Algorithm (FA), Bat Algorithm (BAT), Particle Swarm Optimization (PSO), and Genetic Algorithm (GA).

Furthermore, the sine cosine algorithm (SCA) has been widely used to solve different optimization problems in several fields, such as scheduling (Das et al., 2018), path planning (Tawhid & Savsani, 2019), and forecasting (Li et al., 2018; Gabis et al., 2021). Additionally, in the related literature, SCA has shown efficient results in optimizing neural networks for predicting fish liver enzymes (Sahlo et al., 2016), breast cancer classification (Majhi, 2018), image classification (Song et al., 2019), and electricity load demand forecasting (Hamdan et al., 2017).

Inspired by this, neural networks trained by SCA are employed to optimize missing time series rainfall data in this study. The remainder of this chapter is structured as follows: Section 2 introduces the sine cosine algorithm, Section 3 describes the study region, material, and method used, and Section 4 presents the results and key findings from the experiments conducted in this chapter. Concluding remarks and future works are further presented in Section 5.