

# **METAHEURISTIC ALGORITHMS AND NEURAL NETWORKS IN HYDROLOGY**

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

# Metaheuristic Algorithms and Neural Networks in Hydrology

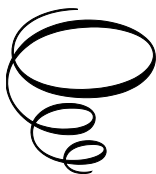


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# TABLE OF CONTENTS

Chapter 1 .....	1
Neural Network – A Black Box Model Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Khairul Anwar Mohamad Said, Chin Mei Yun	
Chapter 2 .....	35
Particle Swarm Optimization in Feedforward Neural Networks for Rainfall-Runoff Simulation Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Chin Mei Yun, Mohd Elfy Mersal	
Chapter 3 .....	63
Bat Optimisation Neural Networks for Rainfall Forecasting: Case Study for Kuching City Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Chin Mei Yun, Mohd Elfy Mersal	
Chapter 4 .....	83
Cuckoo Search Optimization Neural Network Models for Forecasting Long-Term Precipitation Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Khairul Anwar Mohamad Said	
Chapter 5 .....	105
Whale Optimization Neural Network for Daily Water Level Forecasting Considering the Changing Climate Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Teng Yeow Haur	
Chapter 6 .....	129
Salp Swarm Optimization Neural Network for Daily Water Level Forecasting with the Impacts of Climate Change Kuok King Kuok, Teng Yeow Haur, Chiu Po Chan, Md Rezaur Rahman, Muhammad Khusairy Bakri	

Chapter 7 .....	147
Missing Daily Rainfall Prediction using Grey Wolf Optimizer-based Neural Network Lai Wai Yan, Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Muhammad Khusairy Bakri	
Chapter 8 .....	170
Development of Multi-Verse Optimizer in Artificial Neural Network for Enhancing the Imputation Accuracy of Daily Rainfall Observations Lai Wai Yan, Kuok King Kuok, Chiu Po Chan, Md Rezaur Rahman, Muhammad Khusairy Bakri	
Chapter 9 .....	194
Sine Cosine Algorithm based Neural Network for Rainfall Data Imputation Po Chan Chiu, Ali Selamat, Kuok King Kuok	
Chapter 10 .....	208
Hybrid Sine Cosine and Fitness Dependent Optimizer for Incomplete Dataset Po Chan Chiu, Ali Selamat, Kuok King Kuok	

## 5. Book's contents

### CHAPTER 7

#### MISSING DAILY RAINFALL PREDICTION USING GREY WOLF OPTIMIZER-BASED NEURAL NETWORK

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#### Abstract

*This research chapter presents the integration of the Grey Wolf Optimizer (GWO) algorithm for training a Feedforward Neural Network (FNN) to address the issue of missing daily rainfall records. A case study was conducted to assess the efficacy and reliability of GWO in overcoming the limitations associated with conventional FNN training algorithms, which often get stuck in local optima. The performance of the developed GWOFNN approach was evaluated in handling 20% of missing daily rainfall observations at Kuching Third Mile Station. Comparative analyses were made against the Levenberg Marquardt Feedforward Neural Network (LMFNN) and the K-Nearest Neighbour (KNN) algorithm;*



*both were acknowledged for their reliability in addressing missing rainfall data. The results indicate that GWOFNN outperformed KNN and LMFNN in the coefficient of correlation ( $r$ ) and mean absolute error (MAE) performance criteria.*

**Keywords:** Grey Wolf Optimiser (GWO), Levenberg Marquardt (LM), hyperparameter, missing data prediction, K-Nearest Neighbour (KNN)

## **1. Introduction**

Rainfall data is one of the essential observed environment data for hydrological and ecosystem modeling, where the performance of most hydrological models relies on the collected data's availability and accuracy (Kim & Ryu, 2016). However, missing rainfall data is unavoidable due to errors and mistakes during the data collection. Generally, missing data can be caused by a defect in machinery and equipment, human error in managing the data, and natural disasters that may damage the equipment on site. Conventional approaches such as zero substitution, mean substitution, and data deletion are often used to treat missing data at the preprocessing stage (Gill et al., 2007; Chiu et al., 2021a). However, these approaches are not recommended, as valuable information and data distribution may not be preserved, resulting in biased prediction studies. Hot deck imputation is another approach that can be used to replace the missing precipitation data. Malaysia's current practice is to impute the missing precipitation data by substituting the missing values using the measurements from neighboring gauging equipment or rainfall stations at the same timeline (Malek et al., 2010; Chiu et al., 2021b). Nonetheless, this method is not feasible as missing data may co-occur at the neighboring observations, and it is yet scientifically proven to be accurate (Lai et al., 2023).

The data imputation model is currently one of the most popular approaches to treat missing data in various fields. The data imputation model can be derived from data mining, machine learning, and regression techniques. Empirical artificial intelligence (AI) based imputation approaches that include Artificial Neural Network (ANN) and data mining-based imputation models are favored in recent imputation studies to address the missing data of many research fields. Empirical models are also known as data-driven or parametric models that only consider the information from the existing data without accounting for the complex features and processes of the hydrological system (Dawson & Wilby, 2001; Devia et al., 2015). Reduced consideration of features and processes