



# Optimum design of space trusses using water cycle algorithm

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## Abstract

In this paper the water cycle algorithm (WCA) is utilized for sizing optimization of space trusses. Finding the optimum design of 3-D structures is a difficult task as the great number of design variables and design constraints are present in optimization of these type of structures. The efficiency of the WCA are demonstrated for truss structures subject to multiple loading conditions and constraints on member stresses and nodal displacement. Numerical results are compared with those reported in the literature where the obtained statistical results demonstrate the efficiency and robustness of WCA where it provided faster convergence rate as well as it found better global optimum solution compared to other metaheuristic algorithms.

**Key words:** water cycle algorithm, weight optimization, space trusses

## 1. Introduction

Structural optimization techniques are quite well adapted for structural design problems and they are commonly used at the present time. When designing structures, engineers have to consider not only the load-carrying capacity of the structures but also the cost to construct them. Material cost is one of the major costs in construction. Designs that use the smaller amount of materials are therefore preferable, given that the construction methods do not become too expensive or impractical. To achieve this goal, optimization techniques have been employed in structural design [1-5]. There are many conventional optimization methods [6-7], each of which may work well for some specific problems. To select appropriate optimization methods for structural design, it is necessary to understand characteristic of this kind of optimization problem. The first important characteristic of structural design optimization is that, in structural design optimization the solution sought is the global optimal solution. Moreover, in structural design, design variables are generally discrete variables. Finally, structural design optimization always contains constraints [8]. Hence, choosing suitable optimization technique is an important concern to satisfy all these three major characteristics.

There are many optimization methods for solving engineering design problems. These approaches are derivative-free methods and make use of the ideas inspired from the nature