LIST OF PUBLICATIONS

**Journal publications:**


**List of papers communicated:**

Truss topology optimization: A review.

Truss topology optimization with static and dynamic constraints by integrating simulated annealing into passing vehicle search algorithms.

**International conference:**

Modified Sub-Population Based Heat Transfer Search Algorithm for Structural Optimization

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ABSTRACT

In this study, a modified heat transfer search (MHTS) algorithm is proposed by incorporating sub-population based simultaneous heat transfer modes viz. conduction, convection, and radiation in the basic HTS algorithm. However, the basic HTS algorithm considers only one of the modes of heat transfer for each generation. The multiple natural frequency constraints in truss optimization problems can improve the dynamic behavior of the structure and prevent undesirable vibrations. However, shape and size variables subjected to frequency constraints are difficult to handle due to the complexity of its feasible region, which is non-linear, non-convex, implicit, and often converging to the local optimal solution. The viability and effectiveness of the HTS and MHTS algorithms are investigated by six standard trusses problems. The solutions illustrate that the MHTS algorithm performs better than the HTS algorithm.

KEYWORDS
Fundamental Frequency, Meta-Heuristics, Shape and Size Optimization, Truss Structure Optimization

1. INTRODUCTION

The dynamic behavior of an engineering structure mainly depends on their fundamental natural frequencies. Thus, limitations on the fundamental natural frequencies can minimize the destructive effect on the engineering structures. Also, engineering structures should be as light as possible. However, minimization of mass has an adverse effect with the frequency constraints and increases the further difficulty in structural optimization. Therefore, an efficient optimization method is desirable to design trusses subjected to frequency constraints, and continuous efforts are put by the researchers in this aspect.

Optimization of truss structure can be categorized into three types: size optimization, shape optimization, and topology optimization. Size optimization deals to set the best cross-sectional areas, while the nodal positions of the truss structure are assumed to design variables in shape optimization. Many scholars have been investigating simultaneous shape and size optimization of trusses subjected to multiple natural frequency constraints, yet this is an emerging field of research, and it remain not completely addressed so far. Bellagamba and Yang (1981) reported pioneering work in this field.

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Adaptive symbiotic organisms search (SOS) algorithm for structural design optimization

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Abstract

The symbiotic organisms search (SOS) algorithm is an effective meta-heuristic developed in 2014, which mimics the symbiotic relationship among the living beings, such as mutualism, commensalism, and parasitism, to survive in the ecosystem. In this study, three modified versions of the SOS algorithm are proposed by introducing adaptive benefit factors in the basic SOS algorithm to improve its efficiency. The basic SOS algorithm only considers benefit factors, whereas the proposed variants of the SOS algorithm consider effective combinations of adaptive benefit factors and benefit factors to study their competence to lay down a good balance between exploration and exploitation of the search space. The proposed algorithms are tested to suit its applications to the engineering structures subjected to dynamic excitation, which may lead to undesirable vibrations. Structure optimization problems become more challenging if the shape and size variables are taken into account along with the frequency. To check the feasibility and effectiveness of the proposed algorithms, six different planar and space trusses are subjected to experimental analysis. The results obtained using the proposed methods are compared with those obtained using other optimization methods well established in the literature. The results reveal that the adaptive SOS algorithm is more reliable and efficient than the basic SOS algorithm and other state-of-the-art algorithms.

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Keywords: Truss optimization; Shape and size optimization; Symbiotic organisms search (SOS); Meta-heuristic

1. Introduction

The design optimization of an engineering structure subjected to dynamic behavior is a challenging area of study that has been an active research area for many years. Thus, structural optimization with frequency constraints has been getting significant attention in the past decades. The fundamental natural frequencies of an engineering structure are extremely useful parameters to improve the dynamic behavior of the structure [25,34]. Therefore, some appropriate limits on the natural frequencies of the structure can help to avoid resonance with the external excitations [21]. In addition, engineering structures should be as light as possible, so as to make them cost effective [15,31,45]. On the other hand, weight reduction conflicts with the frequency constraints and induces difficulty in the structural optimization [44,47]. Therefore, an efficient optimization method is required to design the trusses subjected to fundamental frequency constraints and continuous efforts are put by the researchers in this direction.

Structural optimization can be broadly classified into two categories: discrete structural optimization and continuum structural optimization. Discrete structural optimization is also known as truss optimization and having connectivity of finite dimensions as dimensions as variables (naturally discrete parameter system) and continuum structural optimization have field as a variable (discretized parameter system) [1,28,3,46,48]. The optimization of truss structure can be classified into three categories: size optimization, shape optimization, and topology optimization. Size optimization works to find the optimal element cross-sectional areas, whereas shape optimization works to find the optimal nodal positions of definite joints in the truss structure. The effect of shape and size variables on
Modified sub-population teaching-learning-based optimization for design of truss structures with natural frequency constraints

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Truss topology optimization with static and dynamic constraints using modified subpopulation teaching-learning-based optimization

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Modified meta-heuristics using random mutation for truss topology optimization with static and dynamic constraints

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Abstract

In this paper, simultaneous size and topology optimization of planar and space trusses subjected to static and dynamic constraints are investigated. All the benchmark trusses consider discrete cross-sectional areas to consider the practical aspect of manufacturing. Moreover, Trusses are considered with multiple loading conditions and subjected to constraints for natural frequencies, element stresses, nodal displacements, Euler buckling criteria, and kinematic stability conditions. Truss topology optimization (TTO) can be accomplished by the removal of superfluous elements and nodes from the highly hyper static truss also known as the ground structure and results in the saving of the mass of the truss. In this method, the difficulties arise due to the singular solution and unnecessary analysis; therefore, FEA model is reformulated to resolve these difficulties.

The static and dynamic responses to the TTO problems are challenging due to its search space, which is implicit, non-convex, non-linear, and often leading to divergence. Modified meta-heuristics are effective optimization methods to handle such problems in actual fact. In this paper, modified versions of Teaching-Learning-Based Optimization (TLBO), Heat Transfer Search (HTS), Water Wave Optimization (WWO), and Passing Vehicle Search (PVS) are proposed by integrating the random mutation-based search technique with them. This paper compares the performance of four modified and four basic meta-heuristics to solve discrete TTO problems.

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Keywords: Teaching-Learning-Based Optimization; Water Wave Optimization; Passing Vehicle Search; Structural optimization; Discrete optimization; Heat Transfer Search

1. Introduction

The majority of the Truss Topology Optimization (TTO) problems reported in the literature have been considered with only stress and displacement constraints. Yet, few studies have been covered by considering frequencies and buckling constraints along with stress and displacement constraints [1-5].

The natural frequencies of an engineering structure are an essential parameter when such structure is subjected to the dynamic excitations [1,6,7]. Many engineering structures are subjected to dynamic excitation due to the working condition and certain unpredicted circumstances that may lead to unwanted vibrations [8]. Such a state becomes dangerous if the dynamic responses produce resonance; therefore, some convinced restrictions should be enforced on natural frequencies to protect an engineering structure [2,9]. Moreover, frequency constraints increase the complexity of the TTO problems [10]. Buckling can also have consequence effect and it includes additional complexity, which makes the TTO problems more challenging [11-17]. Moreover, simultaneous consideration of natural frequencies and buckling constraints adds more limitations to the TTO problems [1]. On the contrary, these constraints cannot be ignored in order to assure practicability of a structure. Kinematic instability and invalid
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Size, shape, and topology optimization of planar and space trusses using mutation-based improved metaheuristics

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Truss optimization with natural frequency bounds using improved symbiotic organisms search

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