
16-17 July 2020, Istanbul, Turkey
Preface

International Conference on Harmony Search, Soft Computing and Applications (ICHSA) is a prestigious academic event, where both potential and young researches are met to discuss their knowledge and study. In 2020, the venue of the sixth edition of the event was Istanbul, Turkey. Unfortunately, we must organize the event online due to Covid-19 outbreak because of travel restrictions and health care. The conference is online organized with the support of Istanbul University – Cerrahpaşa.

The abstracts of the presented papers of ICHSA 2020 can be found in this book. The proposed studies include novel algorithms, advance modification of harmony search or other algorithms, hybrid algorithms, machine learning and artificial intelligence applications in science, engineering and management, structural optimization, soft computing applications in engineering.

We are sad to not meet face to face in Istanbul and not getting together in social events. We wish to meet everyone in another event in future health days. Also, we welcome everyone to Istanbul to see all the beauties of the city.

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Prediction of Soil Plasticity Index with the use of Regression Analysis and Artificial Neural Networks: A specific case for Bakırköy District

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Abstract. Consistency limits are precious soil parameters that are directly representing mineralogical and physical properties of fine grained soils. The consistency limits, are also used to estimate strength and rigidity properties of clayey soils indirectly. Therefore consistency limits of fine grained soils are considered as fundamental properties and they are evaluated as the standard entries to any soil research program. However the consistency tests are assumed as the simple and basic tests of geotechnical engineering, the application details of the tests endamage their reliability and correctness. In this project, it is aimed to evaluate the engineering characteristics of fine grained soils by taking into account the values of consistency limits with the use of both regression analysis and artificial neural networks. A database is prepared by the use of 1500 soil investigation reports that are involving the site characterization informations, laboratory and field tests about İstanbul Province European side clayey soils. Numerical relationships are tried to be developed to determine the values of engineering properties of soils such as plastic limit and plasticity index directly from liquid limit tests. In addition to these the strength and rigidity characteristics of specified high and low plastic clayey soils are also investigated and the evaluated relations or equations are compared with the well-known sources from literature.

Keywords: Consistency limits, Regression analysis, Plasticity index, Artificial neural network.
Solving engineering optimization problems with new optimization algorithm

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Abstract. Several real world engineering optimization problems are highly nonlinear and constrained. It means that objective function is to be optimized under a set of constraints. Such problems are known as constrained optimization problems or nonlinear programming problems and they contain a mixture of discrete and continuous variables. Solving these problems has been challenging for many decades even until now. In this work, we present a new optimization algorithm based on morphological filters, to propose a constraint-handling approach that eliminates the penalization of solutions. The algorithm search the minimum objective function value in the neighborhood of filters using the morphological transformations, in order to obtain the global optimum in a multidimensional space. The performance of the constraint-handling approach was shown with different mathematical function minimization. The results show that we can find very good solutions. Also, the optimization algorithm is validated using standard engineering design problems reported in the specialized literature and it is compared with respect to algorithms representative of the state-of-the-art in the area. The engineering results demonstrate that the proposed algorithm performs well in terms of efficiency and robustness.

Keywords: Constraint Optimization, Stochastic Search, Mathematical Morphology, Engineering Problems.
Control of a jacket platform under wave load using ATMD and optimization by HSA

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Abstract. Jacket platforms are life bloods of oil-rich countries and one of the well-studied offshore structures subjected to environmental loads. In the Persian Gulf, wave loads are the dominant load in designing procedure. Vibration control of jacket platforms is always one of the important issues for demanding requirements such as production activity, safety and serviceability. Tuned Mass Damper (TMD) is one of the well-established control systems in this context. The present study investigates the dynamic behavior of the Ressalat platform located in the Persian Gulf under the wave loads. An Active Tuned Mass Damper (ATMD) is employed for vibration control, while taking the actuator saturation into account. A fuzzy controller is applied to calculate the control force. Moreover, the Harmony Search Algorithm (HSA) is examined to optimize the power of the actuator in the control system. Results obtained through this study indicate superior performance of the proposed ATMD in comparison to the TMD, leading to significant reduction in vibration of the Ressalat platform under studied wave loads.

Keywords: Jacket platform, Tuned mass damper, Harmony search algorithm, Fuzzy control, Wave load.
Deep Learning approach to Normal Boiling Point prediction from experimental data with reported uncertainty

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Abstract. Several approaches have been used to develop physical properties predictive models solely from molecular structural information, which is desirable for industrial applications when dealing with new compounds. We propose a data-driven machine learning-centered pipeline that involves a supervised learning molecular classification step followed by a Molecular Graph Convolutional Network (GCN) in order to predict Normal Boiling Point Temperatures from structural information only. Our dataset includes uncertainty values for each experimental measure and in order to leverage this information, we present a modified loss function that takes into account the "reported reliability" of each data point and its ground truth value. Our approach works on a wide range of compounds and shows a prediction accuracy of over 96% for an unbiased validation set. An atom-level contribution for each molecule is also carried out to further analyze particular cases that do not follow the underlying distribution of the dataset.

Keywords: Physical properties prediction, Boiling point prediction, Machine learning, Molecular graph convolutions, Molecular classification, Molecular featurization, Experimental uncertainty.
Defects detection in Fruits and vegetables using image processing and soft computing techniques

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Abstract. In the sciences of agriculture, automation helps to improve the country’s quality, economic growth, and productivity. The fruit and vegetable variety influences both the export market and quality assessment. Their market value is a key sensory feature of vegetables and fruit, which affects consumer preference and choice. Although a person can do sorting and grading, it is inaccurate, time-consuming, unreliable, subjective, hard, expensive, and easily influenced by the surroundings. Therefore, intelligent classification is necessary for vegetables and fruit, along with the system for detecting defects. This research aims to detect external defects in vegetables and fruit-based on morphology, color, and texture. For this work, the various algorithms proposed for quality inspection, including external fruit defects (i.e., RGB to L*a*b * color conversion and defective area calculation methods, are used to recognize errors in both Apple and Orange) and vegetables (i.e., K-means cluster and defective area calculation methods are used to identify defective tomatoes in color), image techniques are used. For this work, the various algorithms proposed for quality inspection, including external fruit defects (i.e., RGB to L*a*b * color conversion and defective area calculation methods, are used to recognize errors in both Apple and Orange) and vegetables (i.e., K-means cluster and defective area calculation methods are used to identify defective tomatoes in color), image techniques are used. The overall accuracy achieved is 87% (apple: 83%; orange: 93%; and tomatoes: 83%) of defective fruit (apple and orange) and vegetables (tomatoes).

Keywords: Fruit and vegetables grading, Image processing, Quality analysis, Fruits, Vegetables.
A framework for Quality evaluation of Edible nuts using computer vision and soft computing techniques

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Abstract. Generally, humans are used edible nuts as food (edible oils, condiments, spices, or drinks) since from prehistoric times. The foods are high in protein, minerals, vitamins, and energy so-called as nutritive of human foods. The requirement for precise, quick, and unbiased quality determination of these features increases with increasing demands of decent quality and safety requirements for food products. To satisfy these criteria, digital perception and soft computing provide alternatives to an adaptive, non-destructive, and economical approach. This study has identified a wide range of applications in the food industry, based on image analysis and processing. The consistency study of meat and seafood, bakery food like bread, pizza, cheese, and biscuits were conducted effectively in computer vision and soft computing. Therefore, this study has been tested on the quality and characteristics of edible nuts.

Keywords: Edible nuts, Computer vision, Image processing, Soft computing, Quality evaluation.
A Recurrent Neural Network Model to Predict Drought Index Using Hydrological Data

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Abstract. Drought affects a wider area for longer duration than other disasters. Recently, the severity and frequency of drought have been increasing during the last two decades because of climate change. In order to prepare and react to severe droughts, drought impact factors (hydrological and atmospheric) should be identified and monitored. While various feature selection methods (e.g., Principal Component Analysis, Linear Discriminant Analysis) have been applied to address such problem, the spatial correlation of the factors could not be considered in the methods. To overcome the limitation, this study proposes a novel Convolution Neural Network (CNN) model to derive the critical hydrological/atmospheric impact factor on several drought events. A regional snapshot of spatial drought impact factors (e.g., temperature, rainfall, humidity) is converted to two-dimensional image data which is then provided to the input layer of CNN. The proposed CNN model is trained with data obtained under historical drought events in B-city of Korea to predict a drought index called Standardized Precipitation Index (SPI) and seek the most relevant hydrological/atmospheric factors.

Keywords: Climate change, Drought impact, Hydrological/Atmospheric factor, Convolution neural network, Standardized precipitation index.

Acknowledgment: This research was supported by a grant (2019-MOIS31-010) from Fundamental Technology Development Program for Extreme Disaster Response funded by Korean Ministry of Interior and Safety (MOIS).
Discovery of Spatial Patterns of Types of Fuels used in the Districts of India using Data Mining Techniques

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Abstract. The aim of this paper is to apply data mining techniques to analyse the types of fuels used in India. Energy is essential to meet most of the basic needs of the people such as cooking, boiling water, lighting and heating. It is also necessary for good health if the sources are clean, as this reduces exposure to health damaging pollutants and the consequent implications. Also, there is poor knowledge of the health effects of prolonged exposure to smoke from unclean cooking fuel among the respondents and this has serious implications for indoor air pollution. There is an urgent need for health/hygiene education on the health effects of use of unclean indoor cooking fuel among these residents. Applications of spatial data analytical techniques has increased in the last few years in almost all fields. Some of the applications are decision making in regional governance, to maintain law and order, disaster prediction and many more. The main objective of this paper is to find the clusters of cooking fuel usage and to find the correlation between the usage and availability using spatial data mining techniques. The government can use the outcome of the study to reduce or to find the alternate resources of less polluted fuels.

Keywords: Data mining, Clustering, Correlation.
A hybrid data clustering algorithm based on K-means and mountain means algorithm

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Abstract. A hybrid clustering algorithm of K-Means and the mountain means algorithm is proposed. In the first stage, mountain means method is used to select required number (k) of best initial cluster centers. The cluster means found through the former method is used as an initial cluster centers in K-Means clustering. In the second stage, K-Means clustering is applied to make k clusters by using initial cluster centers data cluster, mountain clustering method obtained from former method. In order to find optimal number of clusters, the mountain means method is applied to the data set to find k=2….n cluster centers. For each K, the K-Means clustering algorithm is applied to the data and clusters are identified. The quality of clusters of each cluster set is computed using silhouette coefficient and best k clusters are identified. The k-means clustering is simple and proved to be one of the prominent algorithms used in the industries. The testing of three data base indicate that the proposed hybrid clustering algorithm can identify and categorize the optimal k clusters more efficiently.

Keywords: Data cluster, Mountain clustering method, K-means clustering, silhouette coefficient
Performance Quantification of Search Operators in Hybrid Harmony Search Algorithms

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Abstract. From traditional trial-and-error approaches to mathematical approaches, many engineers tried to solve optimization problems. Recently, meta-heuristic algorithms have been successfully applied to a number of complex optimization problems. However, meta-heuristic algorithms show different performance depending on the problem applied. Therefore, there have been many researches to solve these problems by developing improved algorithms and self-adaptive algorithms. However, no research has been conducted to quantify performance of search operators in algorithms, because purpose of developing many algorithms is to improve performance of algorithms by using existing operators. In this study, performance of search operators in two meta-heuristic algorithms, genetic algorithm (GA; Goldberg, 1989) and harmony search algorithm (HSA; Geem et al., 2001), and two newly developed hybrid algorithms, HS with crossover operator in GA and HSA with formula in particle swarm optimization (PSO; Eberhart and Kenndy, 1995), are quantified. The optimization process is divided into five sections to see the performance of search operator according to the section. These algorithms are applied to five mathematical benchmark problems and tendency of operators is found. For the original HSA, as optimization proceeds, the number of finding optimal solution (NFOS) increases, because HSA uses harmony memory consideration (HMC) operator almost 100% at last section of optimization process to find optimal solution. Hybrid HSAs developed in this study show the same result for HMC, but they show different results for pitch adjusting (PA) operators. For GA, NFOS and crossover operator shows decreasing tendency as the optimization proceeds.

Keywords: Operator, Meta-heuristic Algorithm, Hybrid Algorithm, Harmony Search Algorithm.

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Exploration–exploitation in Sine Cosine Algorithm: a critical analysis and a new improvement based on mutation strategy

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Abstract. In recent years, the Sine Cosine Algorithm (SCA) has established its popularity among the researchers due its simplicity and easy implementation. However, some studies have suggested improvements to provide a better balance between exploration and exploitation, so that the candidate solutions can be prevented from getting trapped at local optima. This study analyzes the behavior of the SCA in the context of the above reports and proposes an improvement based on modified search equation and mutation strategy. The evaluation of the proposed variant of the SCA is conducted on 13 well-known and standard benchmark problems and comparison has been performed with some other metaheuristic algorithms.

Keywords: Metaheuristics, Sine cosine algorithm (SCA), Exploration and exploitation, Mutation.
Harmony Search Algorithms for Optimizing Extreme Learning Machines

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Abstract. Extreme learning machine (ELM) is a non-iterative algorithm for training single-hidden layer feedforward neural network (SLFN). ELM has been shown to have good generalization performance and faster learning speed than conventional gradient-based learning algorithms. However, due to the random determination of the hidden neuron parameters (i.e., input weights and biases) ELM may require large number of neurons in the hidden layer. In this paper, the original harmony search (HS) and its variants, namely improved harmony search (IHS), global-best harmony search (GHS) and intelligent tuned harmony search (ITHS) are used to optimize the input weights and hidden biases of ELM. The output weights are analytically determined using the Moore-Penrose (MP) generalized inverse. The norm of the output weights is considered during the training process. The performance of the hybrid approaches is tested on several benchmark classification problems. The simulation results show that the integration of HS algorithms with ELM has obtained compact network architectures with good generalization performance.

Keywords: Harmony search algorithm, Extreme learning machine, Classification.
Classification of surface settlement prediction of stacked twin tunnels by machine-learning prediction models

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Abstract. Surface settlements induced by tunnel excavation in an urban area could cause severe damage to nearby infrastructures. To ensure the safe operation of tunnel boring machine (TBM), surface settlements should be monitored at several levels such as the alert, action and alarm level. In this study, the magnitude of surface settlements was predicted corresponding to the geological, geometrical and TBM operation conditions collected from an actual tunnel excavation site. The predicted surface settlements are categorized into four settlement classes as follows: (i) heaving, (ii) surface settlement < 3 mm, (iii) surface settlement 3-6 mm and (iv) surface settlement > 6 mm. The machine-learning prediction models implemented by the support vector machine and decision-tree algorithm successfully predicted surface settlements for the test data sets. The proposed system can assist TBM operators in optimizing the machine operation parameters such as the face pressure, back grout pressure, thrust and torque.

Keywords: Classification, Machine learning, Surface settlement, Twin tunnel
Machine-learning based pedotransfer function for estimating soil-water characteristic curve: A data perspective

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Abstract. In past decades, numerous pedotransfer functions implemented on the machine-learning (ML) framework have been developed for estimating the soil-water characteristic curve with a certain level of success. Nevertheless, the attributes of those pedotransfer functions were selected typically in a subjective manner. This study conducted a comprehensive analysis of the UNSaturated SOil hydraulic DAtabase (UNSODA), which is commonly used for deriving pedotransfer functions, for exploring the data properties of UNSODA. Furthermore, the attributes potentially governing the prediction accuracy of the ML-pedotransfer function were disclosed by examining the correlation between these attributes and the expected output. The obtained results could not only enhance the efficiency of the data processing step but also provide a statistical ground for selecting the suitable ML model.

Keywords: Pedotransfer function, UNSODA, Data processing
Optimum Transportation Path Assignment within the Airports in Turkey

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Abstract. One of the most encountered and important issues for civil aviation in Turkey is the necessity for handling the visiting order of the inspections or audits of all airports. The required visits or seminars of audits must be arranged very systematically so that the financial loss of not only the airport companies but also the local government is minimized. In this study, with the support of the data supplied from the civil aviation airports in Turkey, the evaluation of the most suitable transportation path in terms of visiting location takes place. To find the most suitable transportation path, the optimization program will be developed. Two novel Stochastic-based optimization (SBO) techniques called Tree Seed Algorithm (TSA) and Symbiotic Organisms Search (SOS) optimization techniques will be utilized for the developed program. In addition, performances of the TSA and SOS techniques will be investigated for the current optimization problem.

Keywords: Path optimization, Stochastic search, Metaheuristic, Tree seed algorithm, Symbiotic organisms search.
Performance of the whale algorithm in space steel frame optimization problems

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Abstract. Frame optimization that contains highly nonlinear and irregular functions and discrete design variables is one of the most challenging optimization problems. Therefore, gradient-based optimization techniques cannot be successful in such problems. Metaheuristic techniques, especially population-based meta-heuristic techniques, perform highly effective in solving the frame optimization problem. However, due to including stochastic processes performances of metaheuristic techniques vary from problem to problem. Accordingly, researches on the performance of novel meta-heuristic techniques on challenging engineering problems still continue. One of the novel meta-heuristic techniques is the Whale Algorithm which is inspired by the bubble-net feeding behavior of humpback whales. The aim of this study is testing the performance of the whale algorithm for space steel frame optimization problems. For this purpose, the whale Algorithm cased frame optimization program will be developed. Benchmark frame structures are selected to compare optimum solutions with literature results.

Keywords: Structural optimization, Metaheuristics, Whale algorithm, Steel frames.
Modeling of Physicochemical Properties by the QSPR Method of Cutting Petroleum Crude Oil

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Abstract. Our study consists in developing mathematical models based on QSPR equations linking the physicochemical properties to the molecular structure for molecules belonging to the hydrocarbon family of the cut of petrol of crude oil which represents from 25 to 30%. 113 compounds were identified, of different types: of which 60% of linear and branched aliphatic type, 20% aromatic and 20% of cyclic nature, empirical correlation expressing the boiling temperature was developed according to topological descriptors. The statistical analysis shows a very good validity of the prediction model of boiling temperature for non-cyclic aliphatic hydrocarbons, the regression coefficient is (R2 = 99%), whether for all hydrocarbons in the gasoline cut or those of the aliphatic hydrocarbon family, their R2 are 67 and 62%, respectively.

Keywords: Boiling temperature, QSPR model, Hydrocarbons, Correlation.
Development of Discrete Artificial Electric Field Algorithm for Quadratic Assignment Problems

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Abstract. Quadratic assignment problem (QAP) is a problem of facility locations of individual resources. QAP is a proven NP-hard challenging optimization problem and has a large number of real life applications in diverse fields such as hospital layout problem, machine scheduling, keyboard design, backboard wiring problem and etc. Artificial electric field optimization (AEFA) is a new metaheuristic optimization algorithm and achieved great success in continuous optimization problems. This paper presents a discrete artificial electric field algorithm for QAP. Due to the combinatorial nature of QAP, the general operations of AEFA such as particle representations, velocity and position update rules and subtraction operations are modified. The proposed algorithm is applied to solve the QAP instances taken from QAP library. The results show the promising performance of proposed algorithm. Finally, the results are validated using non-parametric test.

Keywords: AEFA algorithm, Quadratic assignment problem, Soft computing optimization.
A Review on the Mechanical Properties of Natural Fiber Reinforced Composites

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Abstract. Natural fibers have drawn attention from the researchers and engineers in the recent years due to their mechanical properties comparable to the conventional synthetic fibers and due to their low cost, eco-friendliness and biodegradability. Therefore natural fibers such as kenaf or flux are being considered as a viable replacement for glass, aramid or carbon. Extensive experimental studies are being carried out in order to determine the mechanical behaviour of different natural fiber types such as the elastic modulus tensile strength, flexural strength and the Poisson’s ratio. This paper is a review of the various experimental studies in this field and it summarizes the findings of the researchers about the elastic properties of the major types of natural fiber reinforced composites.

Keywords: Composite materials, Sustainability, Mechanical properties, Cost optimization, Eco-friendliness
Optimal Cost Design of Single-Story Reinforced Concrete Frames Using Jaya Algorithm

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Abstract. A method has been presented for the design of reinforced concrete plane frame systems at minimum cost by using Jaya algorithm. The total material cost is at the objective function, and the cross-sectional dimensions were taken as design variables. These design variables were assigned with candidate solutions according to the rules of the algorithm in the numerical iterations. The total material cost was calculated according to the amount of concrete and reinforcements, and matrix displacement method was used to analyze structures. Reinforced concrete design was done according to ACI 318-05 (Building code requirements for structural concrete and commentary) rules published by American Concrete Institute. These rules are taken as design constraints. The developed method has been applied to a single-story structure for different loading cases. Since the results have a direct match with the expected optimum results, the method is feasible for the optimization problem.

Keywords: Optimum design, Reinforced concrete plane frame system, Jaya algorithm, optimization.
An Interactive Approach of Rule Mining and Anomaly Detection for Internal Risks

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Abstract. How to prevent internal risks to the information system, especially for undefined risks, is a great challenge. A reasonable approach is to mine the behavior rules of internal staff on historical data through various data mining algorithms and then use the behavior rules to detect abnormal behaviors. However, in practice, risk control officers are often not familiar with data mining technologies, so it is hard to make them effectively choose and adapt these algorithms to find internal risks. In this paper, we propose an interactive approach for behavior rule mining and anomaly detection. Firstly, we express behavior rules and abnormal behaviors as complex events uniformly to accommodate different mining algorithms. Then, the internal staff's history behavior logs generated during production are used for mining behavior rules. Next, mined behavior rules are applied to new logs for anomaly detection. Finally, the detected abnormal behavior will be reported to the risk control officer for evaluation, and the feedback will be used for improving mining and detection settings to form a gradual and interactive process. The experiments on the real production data show that the approach is effective and efficient to detect abnormal behavior and can be used to prevent internal risks of the information system of big corporations such as banks.

Keywords: Internal risks, Behavior rule mining, Anomaly detection, Complex events.
Multi-Objective Optimization of the Reinforced Concrete Beam

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Abstract. This paper introduces two kinds of Multi-objective optimization algorithms. The optimal values are determined through Multi-objective functions and various equality and inequality constraints. The optimal value results of the two algorithms with different parameters are discussed. A simplified optimization case of Reinforced Concrete Beam was discussed that minimizes the total cost of reinforced concrete beams while comply with all strength and serviceability requirements for a given level of the applied load. This paper focuses on the differences between Multi-objective Harmony Search Algorithm (MOHSA) and Multi-objective Genetic Algorithm (MOGA) for reinforced concrete beam design subjected to a specified set of constraints by considering aspects of the Harmony Memory Considering Rate (HMCR) parameters in HSA and Population Mutation (Pm) parameters in GA. Through HSA and GA for RC beam problem, with same reference strength, the result using GA has lower cost than using HSA.

Keywords: Reinforced Concrete Beam, Multi-objective Optimization, Harmony Search Algorithm, Genetic Algorithm.
Performance comparison of two hybrid meta-heuristic algorithms for the uncapacitated fixed charge facility location problem

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Abstract. This paper introduces two kinds of Multi-objective optimization algorithms. The optimal values are determined through Multi-objective functions and various equality and inequality constraints. The optimal value results of the two algorithms with different parameters are discussed. A simplified optimization case of Reinforced Concrete Beam was discussed that minimizes the total cost of reinforced concrete beams while comply with all strength and serviceability requirements for a given level of the applied load. This paper focuses on the differences between Multi-objective Harmony Search Algorithm (MOHSA) and Multi-objective Genetic Algorithm (MOGA) for reinforced concrete beam design subjected to a specified set of constraints by considering aspects of the Harmony Memory Considering Rate (HMCR) parameters in HSA and Population Mutation (Pm) parameters in GA. Through HSA and GA for RC beam problem, with same reference strength, the result using GA has lower cost than using HSA.

Keywords: Uncapacitated fixed charge facility location problem, Hybrid algorithm, Harmony search algorithm, Simple genetic algorithm
Effects of Diffuser Condition on Cooling Energy Performance in UFAD System

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Abstract. In this study, the stratification performance of UFAD (underfloor air distribution) system which is a building energy-saving technology was investigated. This is an air conditioning system that can maintain the room temperature with a relatively small supply/exhaust airflow temperature difference and supply air volume. In the world, although various studies on the floor air conditioning system have been conducted, there are a lack of diversity in comparing energy consumption in Korea using modeling, and adverb calculation methods. Therefore, in this study, the EnergyPlus was used to construct a three-story large office model and to evaluate the energy performance according to the number, effective area, and slat angle of the diffusers. As a result, there was little difference in cooling energy consumption according to the change of air supply conditions, and only the fan energy consumption was reduced due to the decrease in the airflow. The floor area of the interior zone occupies 75% of the total floor area, but the cooling energy performance of the interior zone showed little change regardless of the diffuser conditions. It was also confirmed that convection heat increased in the interior zone. Accordingly, the difference in cooling energy consumption is hardly seen, and it is considered that the cooling load is irrelevant to the increase and decrease of energy consumption.

Keywords: UFAD, Diffuser, Effective Diffuser Area, Cooling Energy, Energy Plus
ANN Based Optimized Control of Chilled and Condenser Water Temperatures in VAV System

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Abstract. In this study, we developed a model predictive control (MPC) algorithm for reducing the energy consumption of heating, ventilating, and air conditioning (HVAC) systems in a commercial building. In addition, the energy consumption reduction effect of the MPC algorithm was evaluated. As a research method, we compared and analyzed the electricity consumption when the chilled water temperature and the condenser water temperature were controlled in each time-step based on MP, compared to the conventional control method fixing those two temperatures all the time regardless of the operating conditions. As a result of experimental evaluation of the optimization algorithm, the chiller's electricity consumption was reduced in all load ranges. In particular, the lower the load, the better the reduction of chiller electricity consumption of the MPC algorithm. At loads less than 1000kWh, an excellent electricity consumption reduction of around 30% was obtained.

Keywords: Artificial neural network, Model predictive control, Chilled water temperature, Condenser water temperature, COP.
Grey Wolf Optimizer with Crossover and Opposition-based Learning

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Abstract. Grey wolf optimizer (GWO) is a relatively new optimizer in the field of swarm intelligence. It is based on the leadership hierarchy and hunting behavior of grey wolves in nature. Due to less number of parameters and ease of implementation, it has gained significant interest among the researchers of different fields. However, in some cases, the insufficient diversity of wolves prone it towards the local optima and degrades the performance of GWO. To resolve this issue, a new Grey Wolf Optimizer with Crossover and Opposition-based Learning (GWO-XOBL) is proposed. In the GWO-XOBL, two strategies have been introduced to get a proper balance between exploration and exploitation. First, the crossover is employed to increase the population diversity of GWO. Then, opposition based learning is applied to improve the convergence rate and to avoid the stagnation. To investigate the effectiveness of the proposed algorithm, it is tested on 13 well-known standard benchmark problems. Statistical tests of the numerical results demonstrate that the performance of the proposed GWO-XOBL is significantly better than GWO and nature-inspired algorithms.

Keywords: Grey wolf optimizer, Uniform crossover, Opposition-based learning, Global optimization.
Artificial Intelligence Potential Trends in Military

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Abstract. Artificial intelligence (AI) is the latest trend being implemented in the military sector. Recent advances in this field and the AI explosion in the private sector have served to promote a revolution for government, public service management, accountability, and public value. Incipient research to understand, conceptualize and express challenges and limitations is now ongoing. This paper is the first approach in such a direction; our research question is: What are the current AI trends in the military? We consider that AI has potential benefits in the military applications, HRMS, decision-making, disaster prevention and response, GIS, personalization of services, interoperability, analyzing large amounts of data, detecting abnormalities and patterns, and discovering new solutions through dynamic models and simulation in real time.

Keywords: Artificial intelligence, UAVs, Military technologies.
Enhancing Situational Awareness in Emergency Operations through GIS in Context of Pakistan

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Abstract. The modern state of the art technology called Geographic Information System (GIS) has enhance the war fighting capability in a dynamic way with rapid response. Recent advancements and cooperation of previous standalone technologies especially in the field of geographic information systems, remote sensing (RS), communication, computing, imaging, electronics, telemetry, navigation, and above all miniaturization have opened new avenues for information collection and transmission from the field under the constantly evolving incident reporting and management frameworks attuned to geophysical and socio-economic environment. While manifestation of these frameworks may vary, above mentioned technologies are now accepted as fundamental enablers in the ‘Incident Reporting and Management Cycle’ to meet the informational requirements in a prompt, collaborative and efficient manner. With information being pivotal, ‘information cycle’ of acquisition, collation, analysis, and dissemination integrates it into the decision making. However, at the onset of incident, intensive information requirements related to command, control, coordination and cooperation usually exceed available information. Rescue Operations in all its phases are essentially pivoted on decision making that required updated information from the field. In this research work, we identified the requirements and capabilities for common product of Web-based GIS and shared them jointly, which allowed us to regenerate many of the different objects and software variants which allow software engineer to configure his own application. We then define the functionality and technical architecture of a highly configurable system that uses current technology to develop web-based applications. Lastly, we designed a tool to configure and assemble components to generate desired products. Subsequently the proposed platform is so flexible to create own GIS product as per the specific needs of each customer.

Keywords: Situational awareness, Disaster management, Geographic information system, Remote sensing.
Harmony Search, its Various Applications in Turkey

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Abstract. Harmony search is a music-inspired optimization algorithm for various soft computing problems. This paper reviews various applications of the harmony search algorithm, especially performed in Turkey. The applications include steel sway frame design, parameter estimation of tuned mass dampers, ground motion record scaling, groundwater management modeling, parameter estimation of Muskingum flood model, traffic signal timing, transport energy forecasting, flow shop scheduling, nurse scheduling, time-cost optimization in construction projects, optimal synthesis of linear antenna arrays, and neural network training. We hope to see more vigorous harmony search applications in Turkey in the future.

Keywords: Harmony search, Optimization, Soft computing, Evolutionary computation, Swarm computation, Phenomenon-mimicking algorithm.
Apply a Hybrid Recurrent Model Based on LSTM and Comprehensive Statistical Methods to Predict Soil Displacement for Landslide Monitoring

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Abstract. Landslides usually cause not only severe economic impacts in industrial and agricultural fields, but also human toll and property losses. Although many efforts have been devoted into landslides research, identifying effective predictors is still a long-term problem. Previous research mainly focused on monitoring landslides by including all available factors to construct models with high prediction accuracy. However, they did not consider model efficiency by selecting effective variables and none of them aimed to detect which particular factors should be focused in landslides monitoring. This paper proposes a novel hybrid recurrent method based on LSTM model, ANOVA, and stepwise algorithm to identify which meteorological attributes and soil properties affect soil displacement. Due to the difficulty in accessing landslide monitoring data, soil displacement, which can be treated as a warning sign of landslide if it is accumulated to a certain level, is used in this research instead. Starting with a base model to predict soil displacement time series by conducting a LSTM model with revised cost function, each candidate variable is added to the base model separately and the optimal model in this iteration is selected with the lowest mean squared error. Then ANOVA is used to evaluate whether the current optimal model improves the soil displacement time series prediction significantly, compared to the base model of the previous iteration. Results of our experiments demonstrate that soil moisture content at 10cm, 20cm, and 30cm depths and atmospheric pressure are selected as the most significant factors affecting soil displacement prediction.

Keywords: Landslide monitoring, Soil displacement, Long short-term memory, Time series, Neural networks.
Improvement of Voltage Profile and Loss Reduction Based on Optimal Placement and Sizing of Renewable Distributed Generations using 4-Rule Harmony Search Algorithm

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Abstract. Distributed generation (DG) resources based on solar and wind energies are among the DGs that can optimize the voltage profile and reduce network losses by optimal locating and sizing in distribution systems. In this paper, 4-Rule Harmony Search (4-RHS) algorithm is presented for optimal placement and sizing the renewable DG resources. In this regard, installation of the DG is performed by loss sensitivity factors first in the most candidate buses. Then, the 4-RHS is employed for placement and sizing of DGs from the selected buses. In 4-RHS, an extra rule is added to standard HS. The 4-RHS is studied on IEEE 69-bus distribution system. The results comparison of the 4-RHS algorithm with the standard HS algorithm and other optimization methods in the literature shows the efficiency and effectiveness of the 4-RHS in finding the optimal location and size of renewable DG resources and subsequently reducing losses and improving voltage profiles.

Keywords: Distributed generation, 4-Rule harmony search, Harmony search, Optimal placement, Voltage profile improvement, Loss reduction.
Wear Particle Classification Using Shape Features

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Abstract. Wear debris provides important information about the machine condition that can be used to prevent the loss of expensive machinery. This information is crucial as it is depicting the condition of the machines and it can be used to predict the early failure of the machinery that can prevent the major loss to the industry. Wear debris or particles produced in different parts of machine vary in shape, size, color, and texture. These characteristic features can be utilized to identify the type and origin of the wear debris. Human experts are extremely good in recognizing such objects however, wear judgments are occasionally based on their specific perceptions. The goal is to bring consistency in judging and recognizing wear particles. Keeping in view the above findings, this study focus on the identification of wear particles by using only the shape based features. Different shape features that includes the Histogram of Oriented Gradients (HOG), Rotation Scale Translation (RST) invariant features, solidity, rectangularity, thinness ratio, are extract-ed and used to train various classification models including Support Vector Ma-chine (SVM), k-Nearest Neighbors (kNN), and discriminant analysis classifier. The performance of the classifiers is compared to each other and the classification of debris based on shape features is analyzed.

Keywords: Wear debris, Particles classification, Shape based features, Histogram of oriented gradients, RST invariant features.
Choosing the Appropriate Branch for Participation Banks through Machine Learning

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Abstract. The size of a bank is directly proportional to the number of branches it has. In the traditional banking system, banks try to reach more customers by opening new branches. Each new branch to be opened carries a cost for the bank. Therefore, a feasibility study is required for the new branch planned to be opened. While conducting feasibility studies, demographic information is generally used and it is aimed to open the branch in a place that will provide maximum efficiency. For this purpose, in the first phase of this study, the branch to be opened by a newly established participation bank was found through machine learning. Location data of other participation bank branches that have been in service for many years were used as data sets. With the OPTICS algorithm, a clustering structure was created with at least one kilometer and at least three branches. In the second phase of the study, the priority of the branches decided to open was found through analytical work. In the analytical study, development indices and levels of the cities were used.

Keywords: Location selection, Optics algorithm, New branch selection, Participation bank.
Abstract. Smart time conflict solvers and event time managers are some of the essential tools for educational institutions that can help students to attend events which might conflict with the lecture or other activity timings to gain advantage of the opportunities enriching their professional benefits. Usually, a university timetable has certain time conflicts that remain undiscovered until the time of students’ registration. Therefore, a smart and an innovative approach in terms of a software package is implemented and described in this paper. The developed software uses smart and efficient searching methods for achieving an optimum time match between any group of students and under any specified constraints. Consequently, the devised event organizer can find an optimum time to allocate for the event by finding the best time at which the majority of the intended people are free for the event. In addition, students who struggle with time conflicts between two or more courses can also find the most suitable times in which their time conflicts are resolved. The software searches for classes by locating the time and courses intersections between all the students who are related to such conflicts. These time conflict processes are difficult to handle manually and may be prone to errors.

Keywords: Location selection, Optics algorithm, New branch selection, Participation bank.
The Effect of Initial Values on Metaheuristic-based Optimum Design of Tuned Mass Dampers

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Abstract. In metaheuristic-based optimum design methodologies, algorithm parameters may play important role in three factors. These factors are finding of optimum solutions with the lowest objective function, reaching to final results in a short time and robustness of method for different runs of the same methodology. Although parameter-free techniques or parameter-free algorithms exist, the population number (the number of evaluated design variables) and the choose of initial values are the two problems of all optimization methodologies. Due to these reasons, an alternative approach for development of initial candidate values of design variables is proposed for optimum design of tuned mass dampers for structures under earthquake excitations.

In the proposed strategy, the initial values are assigned with constant values by dividing the range of design variables according to population number. This strategy is compared with the process using randomly defined variables within the selected range. The results of the two approaches were compared according to standard deviation, mean value and minimum value of different runs. The alternative approach is effective in finding robust optimum solutions and fast computational effort.

Keywords: Tuned Mass Dampers, Structural Control, Optimization, Initial value, Metaheuristics.
Robustness of structures with active tuned mass dampers optimized via modified harmony search for time delay

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Abstract. By using structural control techniques, it is possible to reduce structural vibrations resulting due to seismic sources. The implemented control systems need a perfect tuning according to the behavior of the structure and seismic excitations. In this manner, optimization is a must for structural control. Also, the uncertainty and non-linearity of optimization problem prevent the usage of mathematical methods. In this respect, metaheuristic algorithms play an important role in finding optimum parameters using numerical iterations. In the control systems, the robustness against the time delay of the system is also an important factor for realistic active control. In this study, active tuned mass dampers (ATMDs) optimized via modified harmony search (MHS) for reduction of responses of seismic structures is evaluated for time-delay systems. The investigations was done for different time delay values.

Keywords: Active Control, Harmony Search, Time Delay, Active Tuned Mass Dampers, Robustness, Structural Control, Optimization, Metaheuristic.
The Comparison of Classical and Artificial Neural Network-based Formulations for Tuned Mass Damper Optimization

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Abstract. Tuned mass dampers (TMDs) were used to damp vibration of mechanical systems. TMDs were also used on structures to reduce the effects of strong winds and earthquakes. For the efficiency of TMD, optimization of TMD parameters is needed. Several classical formulations were proposed, but metaheuristic methods are generally used to find the best result. Also, the metaheuristic based optimum results are used in machine learning of artificial intelligence models like artificial neural networks (ANN). These ANN models are also used in development of tuning equation via curve fitting. The classical and ANN-based formulations were found according to frequency domain responses.

In the present study, the classical and ANN-based formulation were compared on time-history responses of seismic structure. In comparison, near-fault ground motion records including directivity pulses are used. The ANN based methods have advantages by providing smaller stroke requirement and damping for TMDs.

Keywords: Artificial neural networks, Tuned mass dampers, Structural control, Optimization, Near-fault, Metaheuristic.
Prediction of Optimum 3-Bar Truss Model Parameters with an ANN Model

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Abstract. In this study, a structural engineering benchmark problem from classic literature, which is 3-bars truss model, was handled intended for determination of optimum areas of bars and the minimum volume of the structure, and harmony search (HS) metaheuristic algorithm was utilized to realize this. In here, the main purpose of the study is the prediction of these values directly by using of an intelligent and learnt model. For this reason, after optimization process, training of intelligent machine learning algorithm, which is selected as ANN, was performed and following, the prediction operation was carried out with this developed model by considering of optimization results. Finally, owing to development of prediction model and to be successful about accurate and reliable predict, a test model also was generated to evaluate that main model is used replacing of the optimization process and to find the optimum results belonging any structure model. In this regard, the main prediction model has a capability that it can predict of design variables as optimally, and minimum weight, directly.

Keywords: Optimization, Metaheuristic algorithms, Harmony search, Truss structures, Machine learning, Artificial neural networks, Prediction.
Total Potential Optimization using Metaheuristics: Analysis of cantilever beam via plane-stress members

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Abstract. In addition to classical methods in structural analysis, the exact solution of deformed shape of the structure by using metaheuristic method. According to theory of total potential energy minimization, the static condition of deformed shape of structures can be directly found by assigning the coordinates of the deformed shape of structure, and finding the case with the minimum potential energy. In that case, the analysis process is on optimization process, and metaheuristics are effective in this process. The total potential optimization using metaheuristic algorithms (TPO/MA) is an effective approach for several including plane-stress members. A cantilever beam is presented in the study, and it is solved via plane stress members using TPO/MA. The problem is presented via two meshing options. For the frequent meshing, a hybrid algorithm of Jaya Algorithm (JA) using student phase of Teaching-Learning-Based Optimization (TLBO) is presented. TPO/MA is effective to find similar results with the finite element method.

Keywords: TPO/MA, Metaheuristics, Hybrid Algorithms, Structural Analysis, Optimization.
Evaluation of Metaheuristic Algorithm on Optimum Design of T-Beams

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Abstract. In structural engineering and optimum design of reinforced concrete (RC) members, the existing design constraints formulated according to design regulations proposed for stress-strain capacity of members prevent the direct calculation of optimum design variables which are cross-sectional dimensions. In that case, metaheuristic methods can be easily used to find the optimum dimensions to minimize the maximum cost of an RC member. In this study, several metaheuristic algorithms such as harmony search (HS), teaching-learning-based optimization (TLBO), flower pollination algorithm (FPA) and Jaya algorithm (JA) are employed to find the optimum cross-sectional dimension of T-beam using design regulation: Eurocode 2. According to results, TLBO has advantages comparing to other algorithms for the optimization problem.

Keywords: Reinforced Concrete, T-beams, Structural Optimization, Metaheuristic Algorithms, Eurocode 2.
Hybrid Harmony Search Algorithm for Optimum Design of Vibration Absorber System for Adjacent Buildings

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Abstract. Pounding of building blocks is a dangerous happening during an earthquake. The collision forces occurred between two buildings may result with particular damage at the collision point, and this damage will lead to collapse of buildings. For that reason, a required seismic gap must be provided, but the gap may not be provided in required amounts. Also, if the structures have a flexible base like seismic isolated structures, base displacement must be limited in order to protect isolators from yielding and collision of blocks. For that reason, several control methods can be used, but the essential factor is a good optimization of parameters of the design. In this paper, the optimum parameters of an absorber system connecting both buildings were proposed. In the optimization method, a hybrid Harmony Search (HS) algorithm was proposed. The combined algorithm is Jaya algorithm (JA). The proposed method is more effective than classical HS approach for reduction of the amount of the required seismic gap.

Keywords: Vibration absorber system, Adjacent Buildings, Harmony Search, Jaya Algorithm, Hybrid Algorithms.
Passive Control of Frame Structures by Optimum Tuned Mass Dampers

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Abstract. Tuned mass dampers (TMDs) were used in control of mechanical systems including structures. The civil structure may expose to high vibrations due to earthquakes. In the present study, TMDs positioned on the top of the structure was optimized via a metaheuristic method called Jaya Algorithm. The structure models are modelled in a finite element analysis software to obtain mass and stiffness properties. Then, the structure modelled as a shear building in the optimization process. The optimum TMD was applied to the example structures in the finite element method analysis software to find structural response including base shear force. According to the results, the optimum TMDs are excellently effective in reduction of the total base shear force of frame structures.

Keywords: Tuned mass dampers, Frame structures, Earthquake, Finite element method, Jaya algorithm.
Optimum Design of Reinforced Concrete Retaining Walls under Static and Dynamic Loads Using Jaya Algorithm

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Abstract. In this study, a reinforced concrete retaining wall was dimensioned under static and dynamic loads at optimum cost using the Jaya algorithm, which is one of the metaheuristic algorithms. As an objective function, the total cost for the unit length of the retaining wall and the cross-section dimensions are defined as design variables. Thanks to the single phase of the Jaya algorithm, the solution was reached quickly, and best design variables were obtained with the minimal solution in the objective function comparing to regular calculations. In addition to achieving optimum dimensioning results in terms of safety and cost, the relationship between earthquake and cost has been examined with the optimization method used as a result of the reinforced concrete design made by applying the regulations on the Buildings to be built in Earthquake Zones (DBYBHY, 2007).

Keywords: Cantilever retaining wall, Reinforced concrete structures, Jaya algorithm, Optimum design, Optimization.
Jaya Optimization for Design of Cantilever Retaining Walls with Toe Projection Restriction

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Abstract. In this study; optimum dimensioning of reinforced concrete cantilever retaining wall under static loads was made by developing a method using Jaya algorithm. During the optimization process, retaining wall stability checks, cross section capacities and controls including reinforced concrete structural design rules were made. With the optimum design, it is aimed that the retaining wall cross-section dimensions reach the optimum value. The total material cost is defined as the objective function and the cross-section dimensions are defined as variable. In order to determine the effect of the front-encasement (toe projection), different design limits are entered into the program and program outputs are examined. The results of the analysis showed that the standard deviation value increases as the design limits are getting narrow. The dimensioning of the retaining wall was made according to TS 7994 (Soil Resistance Structures; Classification, Properties and Project Design Principles) and reinforced concrete design was made according to TS 500 (Design and Construction Rules of Reinforced Concrete Structures) rules. The Jaya optimization method has been found to be superior to existing methods and it has been understood that it is appropriate to use the method in the optimum design of the retaining wall.

Keywords: Cantilever retaining wall, Reinforced concrete structures, Jaya algorithm, Optimum design, Optimization.
The Applicability of Regression Analysis and Artificial Neural Networks to the Prediction Process of Consistency and Compaction Properties of High Plastic Clays

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Abstract. In the context of this study, the prediction process of some geotechnical engineering properties of high plastic clays is investigated depending upon the application of both regression analysis and artificial neural networks. In all kinds of site investigation reports prepared to acquire the current situation of the project site, it’s a common fact to perform the consistency tests which are specialized as Atterberg limit tests. Consistency can be defined as an important term, especially for fine grained soils, to appoint the current state of water content of the soil formation in the field. Based on the ease and cost effectiveness of the Atterberg tests, it has become a traditional solution to determine the fundamental design properties such as the rigidity and strength of the soil formation with the use of empirical approaches that are developed according to them. In this context, “compaction” can be an interesting term to investigate the appropriateness of determination of special characteristics of the phenomenon such as the optimum water content and the maximum dry unit weight with the development of a new perspective based on a simplest experimental process formed with only the evaluation of water content. Because, it is a complicated and time consuming process to apply the compaction test beginning of the sample preparation step to the ultimate evaluation step. Hence, in this paper, an integrated study is performed for high plastic clays to acquire the consistency and the compaction properties together with a direct relationship. A huge database was prepared according to the data’s given in the well accepted literature sources by the transmission of liquid limit and plastic limit test results conducted for only the high plastic clays. Besides, simple equations are tried to be obtained to calculate the plasticity index, maximum dry unit weight and optimum water content of the soil respectively. As a result, the applicability of both the regression analysis and the artificial neural network studies to the compaction problem, were compared with each other to procure a reliable determination process.

Keywords: Regression, ANN, Prediction, Consistency, Compaction.
Evaluation of the Learning Management System Selection Criteria Using Analytic Network Process

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Abstract. Distance Education (DE) is a process operated by a software called Learning Management System (LMS). Due to the COVID-19 pandemic, many educational institutions are currently seeking to procure an LMS in order to switch to the DE system or to renew their existing software. Since multiple criteria are taken into consideration in the LMS purchasing process, this can be considered as a Multiple Criteria Decision Making problem. In this study, it is aimed to determine the priorities for the criteria to be used in the LMS selection problem which is considered as Multiple Criteria Decision Making Problem. After the criteria (such as software features, service support and costing) are defined and relations between them are identified; Analytic Network Process (ANP) approach was taken in determining the priorities of the criteria, since the criteria require pairwise comparison and mutual interaction. As a result of the study, the priorities of the criteria were determined.

Keywords: Learning management system, Multi-criteria decision making, Analytic network process.
Evaluating the Seismic Behavior of Stainless-Steel Tubular Columns

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Abstract. Stainless steel (SS) has gained popularity in the construction industry due to enhanced mechanical properties compared to carbon steel (CS) such as higher strength and ductility, corrosion resistance, aesthetic, better fire resistance and lower maintenance cost. This paper presents a detailed numerical study on the buckling behavior of tubular SS circular hollow columns under constant axial and cyclic loading. Numerical models of CS and SS tubular columns are developed using general purpose finite element (FE) software ABAQUS that have been validated using the available test results in the literature. The developed FE models include both material and geometric nonlinearities and initial imperfections. The FE models predict the experimental load-deformation curve, ultimate strength and failure modes with good accuracy. A comprehensive parametric study is carried out to investigate the effect of main key parameters including diameter-to-thickness ratio, baseplate thickness, axial load ratio, and the number of loading cycles on the strength and ductility of SS column sections. Finally, nonlinear pushover and dynamic time history analyses are performed to investigate the seismic performance of SS and CS tubular columns. Three different seismic hazard scenarios, shallow crustal, subduction deep-in slab, and subduction interface earthquake motions are considered for performance assessment. The SS tubular column is proved to have enhanced seismic performance in terms of strength, ductility and post buckling behavior compared to the conventional CS columns.

Keywords: Seismic, Stainless-steel, Finite element analysis.
Selection of Best Cross-Section Combination in 2D Trusses for Weight Minimization

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Abstract. The research aimed to integrate off-the-shelf generative design and structural analysis tools for finding the best combination of cross-sections (among from a given set of cross-sections) for achieving most lightweight 2D truss. The objectives of the research included testing the success of this integration and optimization and also transferring the final optimized model into the BIM environment. The system components included Grasshopper as the generative design tool and Karamba3D as the optimization package and Speckle and Dynamo is used to transfer the final design to into BIM environment. Firstly, the design of a 2D raised heel truss is accomplished using Grasshopper and Karamba3D package, later three optimization tools Galapagos, Opossum and Goat have been utilized to conduct optimization operation. The geometry related inputs for the optimization problem were the number of vertical divisions (webs), peak height, heel height and the span (which can be constrained when required). Other inputs included different loadings of 2D truss and material details. The optimization goal was to achieve the most lightweight design solution for the 2D truss by finding an optimal combination of different sizes of RHS -IPE -HEA steel beams. The results indicate that an optimized structural design can be achieved through the integration of Generative Design and Structural Analysis Tools, and the final design can be successfully transferred into BIM environment.

Keywords: Structural analysis, Integration, Optimization, Galapagos, Karamba 3D, Speckle, Dynamo.
Optimum active controlled SDOF structures under pulse-type ground motions via harmony search

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Abstract. In this study, the active controlled single degree of freedom (SDOF) structures with 0.5s, 1s, 1.5s and 2.0s period are investigated under various pulse-type ground motions (1.5s, 2.0s and 2.5s) to optimally tune the parameters of proportional-integral-derivative (PID) type controllers. The damping ratio value is assumed as 5%. The paper proposes a methodology to determine the proportional gain (Kp), integral gain (Ti) and derivative gain (Td) using Harmony search algorithm (HS) which is one of metaheuristic-based methods. The performance index of active controlled structures is the displacement feedback. Also, the control force limit as 50% of the total mass of the structure and the time delay effect 20 ms were considered in term of feasibility and stability of active controlled structures. According to the results, the optimum tuned PID controller parameters has major effects on the structural responses of SDOF structures.

Keywords: Active structural control, PID controllers, Teaching learning based optimization, Pulse-Type ground motions.
Structural strengthening of RC buildings for enhanced seismic resistance

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Abstract. This study aims to present a strengthening technique for the seismic resistance of existing reinforced concrete (RC) buildings subjected to earthquake effects. The entire process is illustrated with a case study of an existing RC building. In this study, the building is examined with field surveys and numerical analyses. In the first stage, the damage assessment of the building was done with visual inspection and observation of structural members, and then the seismic performance of the examined RC building was determined using a nonlinear analysis method. Accordingly, a strengthening technique is comprehensively presented for this building, which was determined to be seismically insufficient. The enhancement achieved for the sufficient seismic strength is discussed by numerical comparisons considering the analysis results of the structural model that includes the strengthening members proposed in the presented technique. The presented research is important in terms of the numerical determination of the current state of similar RC buildings against the seismic effects, and to verify the feasibility of the proposed strengthening technique.

Keywords: RC building, Seismic performance, Field study, Numerical analysis, Strengthening.
Seismic performance of existing RC framed buildings using pushover analysis method

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Abstract. The aim of this study is to present a methodology on the determination of the seismic performance of existing reinforced concrete (RC) structures subjected to earthquake effects. This paper focuses on the assessment of existing RC structures with a nonlinear analysis (pushover analysis) method. The research is presented with the case study of an existing RC structure. The investigations on this RC structure are done with the field surveys, lab studies and numerical analyses. The first stage of the study includes the assessment of the compliance between the architectural and structural design projects of the related structure. Necessary checks have been made whether the projects of the structure are consistent with its existing state. Secondly, on-site mechanical tests were conducted on the structural members and laboratory tests were performed on the samples collected from the structure. In the last stage, the seismic performance of the structure was determined based on the three-dimensional finite element model prepared for the existing state of the structure. The analysis results are discussed considering the target performance level parameter. The results have shown the importance of designating the appropriate target performance level in the evaluation of the seismic performance of RC structures.

Keywords: Seismic performance, Existing RC structures, Fiber modelling method, Pushover analysis.
Freestyle Rap Harmony Search (FRHS) for Real-time Water Distribution System Operation

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Abstract. A maximum benefit with minimum cost have been pursued in the optimal design of water distribution systems (WDSs). For this problem, trial-and-error methods, mathematical approaches, dynamic programming and meta-heuristic techniques have proposed while satisfying all the hydraulic constraints such as minimum pressure, demand. Recently, various variants of HSA mostly with multiple harmony memories and hierarchical memories have drawn a lot of attentions because of their promising search. In this study, we propose a new version of HSA, free-style rap harmony search (FRHS), with multiple memories among which different types of solutions are shuffled. The core properties of Freestyle rap are Rhyme, Flow and Punch line. In FRHS algorithm, multiple Harmony Memories (HMs) are created as flow property in freestyle rap. When the value of number of solution vector generations (NSVG) is above a certain value as a parameter, the bad solution of each HM is replaced by the good solution of the neighboring HM. The movement of the harmony memory vector is like a rhyme property with similar pronunciation repeated. When NSVG is above a certain value as a parameter, this condition is the same as property of the punch line, the most shocking part of the freestyle rap. First, to check the performance of the algorithm, FRHS is applied to the least-cost design of WDSs. The performance of FRHS and HS is evaluated by how fast to find nearly global optimal solution. FRHS converges to the nearly global optimal solution faster than HS.

Keywords: Freestyle, Rap, Harmony Search, Optimization, Water Distribution System.

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Computation of Axial Symmetric Cylindrical Reinforced Concrete Walls with Domes

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Abstract. This paper presents a computation methodology for optimum design of axially symmetric cylindrical reinforced concrete walls. These walls are made of thin shells. In programming, the flexibility theory is used to analyses axial symmetric cylindrical walls. Reinforced concrete (RC) design is done according to ACI 318-Building code requirements for structural concrete. The generated computer code was performed for different numerical cases of the RC walls including a dome. The investigated cases are for various dome heights. The generated computer code is suitable with the future implementation of metaheuristic-based optimization methods.

Keywords: Shell structures, Flexibility theory, Axially symmetric cylindrical wall, Dome.