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Artificial intelligence in civil engineering examples

Artificial Intelligence in Civil Engineering works on the goal of imitating and executing functions of human brain, logically and intelligently. According to Robert J. Schalkoff in his book ‘Artificial Intelligence Engine’ (January 1990), artificial intelligence is "a field of study that seeks to explain and emulate intelligent behavior in terms of computational processes". The concept of artificial intelligence is extensively used in the field of construction.Artificial intelligence work based on different methods: These can be fuzzy systems, Neural networks, Knowledge based systems or genetic algorithms.20 Applications Artificial Intelligence in Civil Engineering & ConstructionEach and every civil engineering project is associated with risks and uncertainties. This can include the risks regarding task force allocation, mile stone achievement, project costing and overall construction management. Machine learning which is a branch of Artificial Intelligence (AI) is widely used in the domain of civil engineering.The following are few applications of artificial intelligence in civil engineering:For estimating the percentage of soil moisture content and further classifications.In the structural engineering field machine learning can be applied to detect damages using sensory or image data, identifying it's location and extent.Improving productivity by reducing idle time.For predicting maximum dry density and optimum moisture content in concrete.Using image recognition for proper site monitoring, including aspects of safety and dangerous working conditions.Identifying gaps and requirement of materials to cover the tasks without delay.For travel time prediction and sign AI optimization in transportation engineering.Efficient planning, designing and managing of infrastructure using Building Information Modelling (BIM).Utilizing Artificial Neural Network for predicting properties of concrete mix designs.To monitor activity in the construction site and predicting changes in the costing based on raw material market rates.To analyse settlement of foundation and slope stability.For monitor real time structural health of the building, giving warnings on when and where repair is required.Helping in tidal forecasting to aid construction in marine environment.Reducing errors in the project by automatic analysis of data.To develop site layouts and predict risks as part of project management.Finding a solution for damage related to pre-stressed concrete pile driving in foundation engineering.To solve complicated problems in different stages of the project.To make decisions in the design field.In the construction waste management domain and handling of smart materials.For expert monitoring and optimization if costs in the work system.Project management & AIStructural health monitoring based on artificial intelligence in constructionStructural Health Monitoring (SHM) is the process in which data is collected and evaluated to analyse and assess the vulnerabilities in the structural system or frame work. Bridges, pipelines, dams and various other large-scale infrastructure projects can be analysed using the Structural health monitoring process. Genetic Algorithm (GA), a method of incorporating artificial intelligence can be used in synonymously with structural health monitoring to detect damages in the buildings. A successful application of the same is done in the Tamar Bridge project in the United Kingdom.In this case, rather than manual collection of data for detailed analysis, artificial intelligence techniques are used. From raw data acquired by artificial intelligence, important features can be learnt by using a two-stage learning method.Automatic feature extraction from structural vibration signals of the bridge is done using Nyström method in the first stage.Based on features that are extracted, health conditions of the bridge are classified using Moving Kernel Principal Component Analysis (MKPCA) in the second stage.A study on three-storey framed aluminium structure of the bridge, the proposed health monitoring system proved good enough to analyse damages and overall bridge health.Artificial Neural Network (ANN) based on artificial intelligence in constructionArtificial neural network uses methods like Levenberg- Marquardt algorithm (LMNN), differential evolution algorithm (DENN) and Bayesian regularization method (BRNN). This study applies artificial intelligence to find maximum dry density and unconfined compressive strength of cement stabilized soil. The inputs of the study include liquidity limit, moisture content, cement content, plasticity index and fractions of sand, gravel and clay. In addition to Artificial neural networks, support vector machine (SVM) techniques can also be used. Researcher's state that the latter technique gives better clarity on results of unconfined compressive strength and maximum dry density of cement stabilized soil.Artificial Neural Network (ANN) based on artificial intelligence in constructionFor an average liquid limit value of 32.71%, Clay, sand and gravel fractions of 23.39%, 65.09% and 11.61% respectively, plasticity index of 12.73%, moisture content of 10.05% and cement content of 5.63%, the model gives out an average result value of 18.65 KN/m3 dry density and 2.95 N/mm2 Unconfined Compressive Strength (Das et.al. 2011).Artificial neural networks and genetic modelling can also be used to measure the slump of ready-mix concrete. The approximation ability of artificial neural networks is utilized in the study methodology. A relationship is struck between input and output variables.The data for the analysis was collected from the same ready-mix concrete plant so that errors can be avoided with changing composition of the mixes. MATLAB R2011b software is used for the assessment. The software with global optimization and neural network toolbox works to put genetic algorithm into action (Chandwani et.al.2015).Fuzzy systems based on artificial intelligence in constructionFuzzy polynomial neural networks are used extensively for the approximation of the compressive strength of concrete. From three separate sources experimental data of 458 different concrete mixes are collected. Based on the collected data, six architectures of Fuzzy polynomial neural networks are made and tested. The input parameters include concrete ingredients and the output is given as 28 days of compressive strength in the mix design (Zarandi et.al, 2008).Shortcomings of Artificial Intelligence in Civil EngineeringTechnological advancements go hand in hand with a rise in expense. Artificial intelligence implementation in the field of construction requires frequent software up-gradation.Similarly, another aspect of technological invasion is the shortfall of job opportunities for humans. Manpower is better replaced with robotic functions under artificial intelligence. There is significant fall in construction jobs and the existing workforce will continue being affected.Even though artificial intelligence proves useful to reduce potential risks in site, the main limitation is that it can perform only those functions it is programmed to do. Whereas, trained manual workers can also perform tasks with their intellect by thinking beyond the box. Development of complex algorithms specific to construction field requires skilled personnel and requires ample of time to execute.Improvements in technology has certainly made life easier. Construction field which has been foreign to software intrusion till this time, is now witnessing a change. With artificial intelligence and machine learning concepts, more developments can be expected in the coming years as well! what is artificial intelligence in civil engineering

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