



Optimization of Concrete Mix Design Under the Aggressive Environment With Gmdh-type Neural Networks

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Abstract

One of important causes for failure of concrete structures particular in Persian Gulf region is diffusion of chloride into concrete. Prediction of concrete diffusion factor is an important issue as a key parameter in the being cycle of concrete structures.

In addition concrete diffusion factor, increasing in compressive strength and reduction in initial cost is inevitable.

The important conflicting objectives that have been considered in this paper are, namely diffusion factor and 28 days- compressive strength. These objective functions have been selected for two objective optimization process. Group Method of Data Handling (GMDH) algorithm is self-organizing approach by which gradually complicated models are generated based on the evaluation of their performances on asset of multi-input-single-output data pairs. The GMDH was firstly developed by Ivakhenko as a multivariate analysis method for complex system modeling and identification. In this way, GMDH was used to circumvent the difficulty of knowing prior knowledge of mathematical model of the process being considered. In other word, GMDH can be used to model complex system without having specific knowledge of the systems. The main idea of GMDH is to build an analytical function in a feed-forward network based on a quadratic node transfer function whose coefficient are obtained using regression technique. In fact, real GMDH algorithm in which model coefficient are estimated by means of the least squares method has been classified in two complete induction and incomplete induction, which represent the combinational and multilayered iterative algorithms, respectively.

NSGAIL algorithm is used for multi-objective optimization, this algorithm has some problem in the crowding distance subroutine, therefore a new diversity preserving algorithm, named ϵ -elimination, is proposed to enhanced the performance of multi-objective evolutionary algorithms in optimization problems.

Keywords: Concrete, diffusion, Neural network, NSGAIL, Multi Objective Optimization.

1. INTRODUCTION

Per year millions dollars are spent as the result of destruction of concrete structures near seashore and industrial refineries which contain chloride ions. The concrete used in this structures-specially sea structures-should resist against factors such as chloride attack and steel corrosion. In middle east specially in Persian gulf and southern banks of the Iran, the problems in concrete processing with high reliability cause high cost for the country[1]. To solve this problem, the best way protecting from the damage of concrete, we should look for ways leading to determine the life time of the concrete by considering the characteristics of materials and environmental conditions. Economically the best solution for preventing the precocious destruction is increasing the concrete resistance against chloride permeation during the concrete life; On other hand initial cost and repair expenses are important parameters. By operating of laboratory instruments we can produce concrete which can fulfill our needs. But there is no clear way to determine the duration of concrete structures and predicting the diffusion of chloride. The main problem is the vast variation of mixing proportion and huge number of effective parameters [2]. One of the methods for predicting the life time of concrete in the world is gathering the result of experiments and the present structure information for making a model that its usage decreases costs and time, easing in application and flexibility in any concrete structure.

Diffusion factor, 28 days- compressive strength, initial and repair costs have been considered in this