Back Analysis of Mechanical Parameters of Arch Dam Using an Improved BP Neural Network Algorithm

Fayaz asghari ,[1]Hasan Mirzabozorg[2]

1- **Master of Hydraulic Structure Engineering Department of Civil Engineering, K.N.Toosi University of Technology, Tehran**

2- **Associate Professor faculty of Civil Engineering, Structure Department, K.N.Toosi University of Technology, Tehran**

fayaz_asghari@yahoo.com

mirzabozorg@kntu.ac.ir

Abstract : The backpropagation (BP) neural network algorithm was improved and applied to construct a back analysis model for the study of the mechanical parameters of an arch dam. Samples were obtained from forward analysis using the three dimensional finite element method. The obtained samples were then used to train the network, and the measured displacements were applied to invert the mechanical parameters.

 The exact mechanical parameters were calculated and analysed according to the back analysis of parameters. Computational results agree well for some blocks with the measured values, indicating compliance with engineering requirements. Furthermore, the BP neural network algorithm has convergence and corresponds to dam's natural behavior. The results show that the improved BP neural network algorithm and three-dimensional finite element method are feasible techniques for inverting the thermal parameters of arch dams.

Keywords: improved BP neural network algorithm; three dimensional finite element method; displacement; back analysis; mechanical parameter

Introduction

In massive concrete structures, the displacements are affected by many random factors such as material properties, loading condition, thermal parameters, construction process, etc. The random influence of these mechanical parameters is difficult to determine. To measure mechanical parameters directly is usually a complicated task, and laboratory test parameters rarely reflect the authenticity of construction sites because of restrictions on environmental conditions. In practical applications, the inversion method, which measured displacement, can be used to determine mechanical parameters. Repeatedly calling the displacement subroutine to invert elastic mechanical parameters is a complicated time consuming iterative process, which needs substantial computational efforts.

Thus, calculation efficiency has a particular importance. Some researchers have been using neural network in back analysis of RCC dams [1] but none of them has worked on arch dam. However, in this research a multiple arch dam is selected to calculate it's mechanical parameters using back analysis method. This method enables the direct calculation of mechanical parameter values on the basis of the elasticity theory. Nevertheless, the back analysis method is also characterised by certain limitations. For example, if there are many different parameters, maybe it does not converge exactly. Peripheral conditions and the most effective parameters must be chosen carefully to have better converged answers. Considering the complexity and substantial computational requirements in the current work, the three dimensional finite element method and backpropagation (BP) neural network algorithm is used to invert mechanical parameters on the basis of measured displacements data.

Thus, the parameters that reflect actual structural performance can be obtained. The three dimensional finite element method is used in the forward analysis process and linear static analyses are made; this approach effectively reduces the workload involved in displacement calculation and improves back analysis efficiency. The BP neural network algorithm used in the back analysis module utilize the gradient descent algorithm.