Amirkabir Journal of Civil Engineering

Amirkabir J. Civil Eng., 50(4) (2018) 233-234
DOI: 10.22060/ceej.2017.11051.4965

Determining Impending Slip of Slop and Optimized Embankment Operation Volume of Earth Dams Using a Combination of Neural Networks and Genetic Algorithms (GA)

H. R. Saba[1], M. Kamalian[2], I. Raeisizadeh[3]

[1] Tafresh University, Tafresh, Iran
[2] Geotechnical Engineering Research Center, International Institute of Earthquake Engineering and Seismology
[3] Afarinesh institution of higher education, Borujerd, Iran

ABSTRACT: In this study, impending slip of slope and optimized embankment operation volume of earth dams have been determined using optimization benefiting from a combination of neural networks and genetic algorithms (GA). Further, coefficient of slope stability of earth dam have been determined using neural network and has been compared with outputs of finite element software PLAXIS. In order to training the neural network from derivative data, 150 models of earth dams have been used in finite element software PLAXIS.

Slope stability analysis has been done in order to determining the safety factor at desired sliding surface and the most probable fracture process and the least related safety factor. The determination of the most probable fracture process at the impending slip (determining the least safety factor) is the genetic algorithm application. Moreover, another application of genetic algorithm in this research is optimizing the embankment operation volume of earth dam in the manner that minimum of safety factor derived. In this research analysis has been done in order to simpler use of proposed dimensions for engineers using various properties of soil in embankment of earth dam for different heights. Results have been shown as figures and tables which optimal dimensions and volume of the dam without using the software can be derived from them.

Review History:
Received: 2 October 2015
Revised: 13 December 2016
Accepted: 2 January 2017
Available Online: 1 August 2017

Keywords:
Earth Dams
Slope Stability
Neural Network
Genetic Algorithm
Optimization
PLAXIS Software
MATLAB Software

1- Introduction

Optimization methods can be classified into two random search techniques and computational methods. Usually, the exact method of calculation is calculated based on linear programming optimization methods using the same techniques are based. [1-4].

2- finite Finite element software PLAXIS numerical modeling and neural networks to optimize the use of dams

In this study, analysis of homogeneous earth dam stress analysis - nonlinear strain PLAXIS is done by software, and in this study of 150 computer model was used to train the network.

In this study, the following entries have been used for training the neural network. The inputs of the dam height (H), dam crest width (B), the slope of the dam side, friction angle of the soil, the soil bulk density, soil cohesion (C), is provided. For network training, input vector as "accidental" was arranged. This helps to keep the neural network input, but they will not learn .[5].

3- genetic Genetic algorithms to optimize the performance of dams

Corresponding author, E-mail:

Optimize the engineering process of finding the "best" possible values for a set of variables to satisfy various constraints, are concerned. Target, or the minimum is the maximum quantity that decision it wants. Indicating the quantity of returns that a restriction or impediment to the situation shows the system's technological track. In this study, the goal is to optimize the volume of earthwork dam, so that confidence in the stability of the dam, the highest value that the slip threshold is reached (Confidence FS = 1).

It is aimed at taking some terms and conditions. In the beginning of optimization, the objective function is defined in this study, the objective function as a function of the volume of earthworks is as follows:

$$V(x) = x(1) * (x(2) + \frac{x(1)}{\tan(x(3))}) \quad (1)$$

Where X(1) is the height of the dam, X(2) is the dam crest width, X(3) is the slope and V(X) is dam-related function is tofor calculatinge the volume of earthworks dam. Economic solutions, this function reduces and non-economic solutions are fined.

4- Earn at least confidence dam stability

The first part of that same confidence in the stability of earth dams is to obtain at least the screw. dirtDirt, soil bulk density and soil cohesion (C)) is different and will be in the range of

values (Ttable 2). After every confidence (FS = 1), there will be more than one correct answer to gain the confidence to say, many will be achieved due to the high volume of entries, in this article random number of the values given in table Table 3.

5- optimizeOptimizing the volume of earthworks dam

The purpose of this section is to determine the parameters affecting optimization of earthworks dam. So in every episode except the parameters affecting other fixed parameters are considered.

6- Conclusion

According to the charts provided, we see that the parameters such as width and height of the dam crest and the slope of the dam have the greatest impact on optimizing their volume of earthworks dam.

The results of the neural network were compared with the results of PLAXIS and a maximum error of about 2%, respectively.

The neural network can be said for the dam's ability to determine slope stability factor and a very low error rate can be stable for a variety of grades obtained.

Due to the large safety factor in determining the reliability of classical methods to determine the approximate slope stability and reliability of slope stability, it can be said that neural networks are very good and reveal acceptable accuracy. In conclusion, genetic algorithm to determine the minimum acceptable program that the threshold of slip stability factor is FS = 1, is suitable for determining the most optimal volume of earthworks and the dam is capable.

References

[1] Hernandez S, Fontan A. Practical applications of design optimization. Southampton (UK): WIT Press; 2002.

[2] Fletcher R. Practical methods of optimization. Chichester: Wiley; 2001.

[3] Saribas A, Erbatur F. Optimization and sensitivity of retaining structures. ASCE Journal of Geotechnical Engineering 1996;122(8):64956.

[4] Jones T. Artificial intelligence application programming. Hingham (MA): Charles River Media; 2003.

[5] Raisizadeh I."Application of Neural Networks and Genetic Algorithms in Determination of Stability Factor and Optimization of Soil Dam Diversion Volume", Master's Thesis, Arak Azad University.2009.

Please cite this article using:

H.R. Saba, M. Kamalian, I. Raeisizadeh, Determining impending slip of slop and optimized embankment operation volume of earth dams using a combination of neural networks and genetic algorithms (GA), *Amirkabir J. Civil Eng.*, 50(4) (2018) 747-754.

DOI: 10.22060/ceej.2017.11051.4965