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Discussions

Interactive comment on "Application of the LM-BP neural network approach for landslide risk assessments" *by* Junnan Xiong et al.

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Dear Editor and Referees, First of all, we are very thankful for your constructive comments on our study. Specially, we are heartily grateful to your valuable suggestions. The manuscript has been revised carefully and strictly according to your letter. We are submitting our revised version entitled "“Application of the LM-BP neural network approach for landslide risk assessments”, Manuscript ID nhess-2018-360. Please find the revised manuscript with track changes. In order to facilitate your review, bold fonts were used to show revision and changes. In the following "Point-to-point response to the editor's letter and the reviewers' comments". Please do not hesitate to contact me, if further material or information is needed.

Note: All major changes are red-marked in the revised manuscript. Thanks again.

Detailed responses to the comments are addressed below. Reviewers' Comments to Author:

The overall logic of this manuscript is clear. However, I don't think this manuscript conveys a lot of valuable information currently. Besides, the description of some research processes is somewhat ambiguous.

1. First of all, it should be pointed out that the neural network method (machine learning) is a hot topic of current research, and it is even expected to become an important force to promote social development and change. Therefore, I am very willing to affirm the author's far-sighted efforts in the field of machine learning.

Thank you for your comments.

2. Considering the wide application of neural network methods so far, the novelty and significance of this research need to be articulated. Thanks a lot. The first, the system of the vulnerability assessment, considered the pipeline position and the angle between the pipe and the landslide (pipeline laying environmental factors). In previous studies, pipeline vulnerability evaluation indicators only considered the pipeline itself, and the relationship between the pipeline and environment was rarely examined (W. Feng, Zhang, & Zhang, 2014; Shuiping Li, 2008; Yingchun Liu et al., 2015), We also used an interpolation theory to generate the standard sample matrix of the LM-BP neural network. Line 189-194: According to the order of susceptibility from low to high, Interpolation was performed in each interval and the sample vectors of each evaluation indicator were constructed. Each 200 is a susceptibility level, and the sample vector length of each evaluation indicator is 800. The interval of the susceptibility degree is [0, 1], and the output vector is obtained by interpolating 800 values equidistantly between the interval of [0, 1]. Sample matrix is built by interpolation theory, which avoids the excess human influence in the process of building neural network model by traditional methods.

3. The reason for choosing BP neural network among so many machine learning methods should be articulated. It is suggested making a detailed comparison of different methods. Yes, the concrete information of reason for choosing BP neural network has been supplemented. And it make sense to compare different approaches in detail. We will study them in the next step. Line 150-163: BP Neural network with many adjustable parameters has powerful parallel processing mechanism, high flexibility and is good at dealing with a lot of uncertain information. The mechanism of landslide evaluation is complex, with many uncertainties and incomplete information (Jie et al., 2015). The BP neural network model can find out the intrinsic rules from the vast amount of complex and fuzzy data in the changing environment and make corresponding inferences. This method can be applied to the landslide susceptibility assessment of pipeline area with more qualitative information and less quantitative information, and the more accurate assessment results can be obtained from the analysis of these fuzzy information. Landslide susceptibility assessment is essentially a study of pattern recognition (F. Feng, Wu, Niu, Xu, & Yu, 2017). BP neural network can approximate arbitrary continuous function with arbitrary precision, so it is widely used in non-linear modeling, pattern recognition and pattern classification (Xiong, Ran, Xiong, Li, & Ye, 2010). Because the BP neural network model is widely used, there are many successful cases for reference in the number of neurons in each layer, the parameters of network learning and the optimization of algorithms, which can effectively improve the reliability and accuracy of the model(Ke & Li, 2014b).

4. In order to avoid misunderstanding, it should be more appropriate to replace “hazard assessment” mentioned in the manuscript by “susceptibility assessment”, for the meaning of these two expressions is not exactly the same.

It is an important question. We thank you for your valuable comments, and all of the “hazard assessment “expressions have been corrected throughout manuscript.

5. The expressions like “assessment factor”, “evaluation index” and “evaluation indicator” should be consistent.

Thank you, the expression has been corrected according to the comments of reviewer’s

6. In the "Methods" section, the basic theoretical introduction of BP neural network or entropy weight is not found, which may bring difficulties for readers without relevant foundations to accurately understand the following research. Thank you for your valuable comments. The basic theoretical introduction have been added. Line147-150: The neural network, an abstract model of our brain, constructs calculating units connecting with one another. Neural network has an input layer, a hidden layer and an output layer. With its good performance on nonlinear statistical modeling, it is very useful in exploring the hidden relationships between the inputs and the outputs (Z. Wu & Wang, 2016). The flow chart of LM-BP neural network algorithm is shown in Figure 3.

Line 196-208: Entropy is a method of measuring the uncertainty of information by using probability theory (P. Liu & Zhang, 2011). The entropy indicates the extent of difference in an indicator, and the more difference of the data, the greater the role in evaluation (Jia, Zhao, Nan, & Zhao, 2007). The extremum difference method was used to normalize each indicator value. The decision information of each index can be expressed by entropy value ei:

7. Line 58 The description that “most of these methods” should be specific. Thank you, we have re-wrote the sentence. Line 59-62: However, most of these methods are subjective, such as expert evaluations, analytical hierarchy processes, logistic regressions and fuzzy integration methods, which could affect the accuracy and reasonableness of the evaluation (Fall, Azzam, & Noubactep, 2006; Sarkar & Gupta, 2005)

8. Lines 146âĹij147 Considering that there are many optimization methods for BP neural network, the reason for choosing LM algorithm for optimization should be briefly described. Thank you, we have added the reason. Line 166-169: LM algorithm is a combination of gradient descent method and Gauss-Newton method. Its iteration process is no longer along a single negative gradient direction, which greatly improves

the convergence speed and generalization ability of the network (Jing Li, Feng, Wang, & Zhang, 2016).

9. Lines 157âĹij159 “The classification criteria of the evaluation indicators” in this research need to be articulated, for the solution to this problem is currently inconclusive. We thank you for your comments, and classification criteria have been added. Line 180-186: Based on previous research experience and field investigations (Appendix 8), the monotonous intervals of different indicators of susceptibility degrees were judged (Appendix 1). For instance, there were hardly any landslides, only collapses that occurred in slopes above 60 degrees. Besides, the susceptibility degree in the area was monotone decreasing in the interval of [60, 90]. Because of the very small sliding force in a slope at 0 degrees to 15 degrees, landslides were rare to occur here, even under other extreme conditions. (Q. Zhang, Xu, Wu, & Li, 2015)

10. Line 181 Correct the “comparison” to “Comparison”. Done

11. Line 187, Line 204 and Line 213 The reason for grading using “the equal interval method” needs to be explained. In fact, the equal interval method may not be the most appropriate choice. Yes, done. We have supplemented the analysis: Line 251-256: Scientific analysis and expression of disaster risk assessment results can simplify complex risk assessment and make the micro results macro (Ding & Tian, 2013). There is no unified criterion for disaster evaluation zoning, and the equal interval method is one of the methods to express the results more intuitively (H. Hu, Dong, & Pan, 2011; Jin & Meng, 2011; Y. Wang, Hao, Zhao, & Fang, 2011). The susceptibility degrees and vulnerability degrees were distinguished using the equal interval method, and four risk grades were then automatically generated.

12. Line 284 Correct the “Results and comparison” to “Conclusion”. Done

13. Table 3âĹij5 The format of the units in the same table should be consistent. Yes, done.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-360/nhess-2018-360-AC1-supplement.zip

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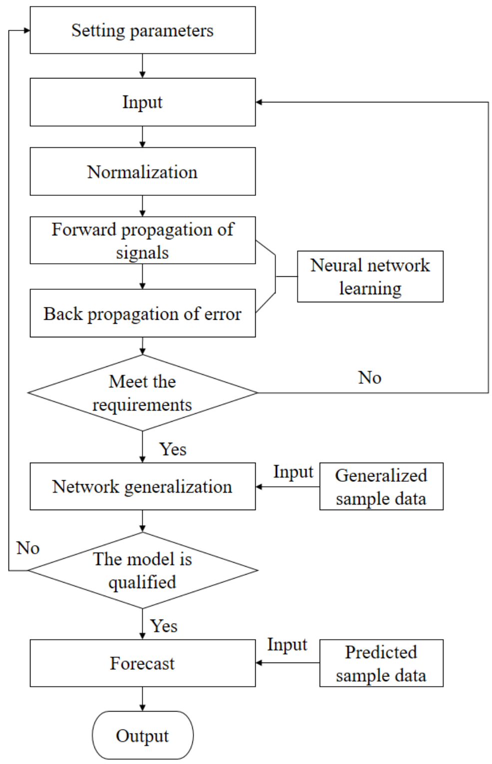

Fig. 1. Figure 3 Flow chart of LM-BP neural network algorithm