Reply to reviewer 1#

Dear reviewer 1#：

We are very grateful to this referee comments, and we have carefully read and considered the referee's comments, and these comments are important for improving the quality of this manuscript. Based on these comments, we have made carefully modification and proofreading on the original manuscript, the revised parts have been marked in red in revised version, and the detail modifications are shown in next chapter.

Thank you very much for your suggestion and consideration, and we look forward to hearing from you.

Best regards,

Yimin Liu and Zhengyang Hou.

Detailed revision:

(1) The fonts on the axes are too small and the labels could be better.

Modification: We have enlarged the fonts on the axes in Figure 10, 11 and 21, and the labels would be better than previous manuscript.

(2) Page 3, Line 68, 69: "but there is no mature and stable instrument and corresponding monitoring technology", this sentence is not so accurate.

Modification: Thanks a lot for your kindness suggestion, due to our carelessness of literature review, we have carefully read and added the literatures you provided in revised version, and rewrite this sentence.

We revised it as: there are only some borehole earth strainmeter, geo-stress sensor or volcano monitoring sensors based on optical fiber sensing, but there is less mature and stable in-situ measurement instrument and corresponding monitoring technology.

(3) Page 10, line 193 you did not find this terms "λ_ε" in the previous equation, could you explain better.

Explaination and modification: We added the Equation 14 to explain "λ_ε", and λ_ε is the wavelength value under strain state.

$$k_\lambda = \frac{\lambda_\varepsilon - \lambda_B}{\lambda_B} \qquad (14)$$

(4) Page 14, Line 262: How do you measure the wavelength shift? and which resolution you have?

Explaination and modification: We measure the wavelength shift by FBG wavelength demodulator, and the demodulator is shown in Section 4.1, and we describle the function and main parameter of the demodulator in line 206. The working principle and process of demodulator are not the focus of this manuscript, this paper focuses on

the design and simulation of the FBG sensor group.

(5) Page 23, Line 415: Please add axes's labels to better understand what is plotted.

Modification: We have added axes's labels in Figure 21. The ordinate represents the label of the FBG corresponding to the residual error, and the abscissa is the label of the corresponding FBG.

Reply to reviewer 2#

Dear reviewer 2#：

On behalf of my co-authors, we thank you for giving us an opportunity to revise this paper, we appreciate editor and reviewers very much for their positive and constructive comments and suggestions on our manuscript. Based on these comments, we have made carefully modification and proofreading on the original manuscript. For the questions from reviewer 2#, I will explain in detail in the next chapter, and the detail modifications are also shown in red in revised version.

Thanks for your suggestions and comments. All your comments are very important. They have important guiding significance for our future research work, and we look forward to hearing from you.

Best regards,

Yimin Liu and Zhengyang Hou.

Detailed revision:

(1) FBG is just sensitive to axial strain. How does the in-situ stress inversion algorithm of hole-wall strain to stress eliminate this kind of error?

Explaination and modification: As you said that the actual strain direction is inconsistent with the FBG axial direction, it doesn't seem to truly reflect the actual strain. According to the hollow inclusion measurement principle (Leeman, 1964; Cai, 2000), that is the stress inversion calculation method of hole-wall strain method and the in-situ stress calculation principle of hollow inclusion cell, any six strain measurement data from different groups can be used to calculate the three-dimensional stress tensor. And the FBG strain sensor described in this paper can replace the resistance strain gauge, and we have more directions and numbers of FBGs due to the innovative layout.

Leeman E. R. 1964. The measurement of stress in rock: Part II: Borehole rock stress measuring instruments [J]. Journal of the Southern African Institute of Mining and Metallurgy, 65(2):254-284.

(2) The epoxy resin can cause the reflection spectra of some FBGs to chirp, which has an impact on the accuracy of FBG wavelength. This factor isn’t considered in the three-dimensional calculation model based on ABAQUS software.

Explaination and modification: As your comment said the factor caused by epoxy resin can not be ignored, and to eliminate and reduce this error, this paper adopts the correction method of epoxy resin layer affecting the stress inversion results(Fama and Pender, 1980). The K_1, K_2, K_3 and K_4 in Equation(9) are correction factors of the epoxy resin influence effect, it's just that there are too many expression formulas, which are not shown in the paper. In the finite element simulation of Chapter 5, the influence of epoxy resin is considered in model establishment, meshing, numerical calculation and in-situ stress inversion. We explained these K_1, K_2, K_3 and K_4 in line

177 of the revised version.

Fama M., Pender M. J. 1980. Analysis of the hollow inclusion technique for measuring In Situ rock stress[J]. International Journal of Rock Mechanics & Mining Sciences & Geomechanics Abstracts, 17(3):137-146.

(3) The author is recommended to give the detailed index parameters of FBG wavelength demodulator.

Modification: We have added main parameters of the FBG wavelength demodulator in section 4.1, and these parameters are shown in Table 3.

Table 3: Main parameters of the FBG wavelength demodulator.

Parameter	Unit	Value
Wavelength measurement range	nm	1525-1565
Wavelength resolution	pm	1
Number of channels	\	4
Sampling frequency	Hz	1~2k
Minimum measurement interval	nm	0.5

(4) The novelty of the proposed method should be discussed. The authors must discuss the improvements of the technique in the submitted manuscript compared with the previous work which should be properly cited.

Modification: Thanks for your kindness and useful sugguestion. We have refined the highlights and innovations again in Chapter 7, and the improvements are analyzed and compared with the previous work from line 69-75 in Chapter 1. The improvements are shown below, and the detail modifications are also shown in red in this paper.

(1) Based on the layout of FBG strain sensor group, a new in-situ stress inversion algorithm is derived.

(2) The process of in-situ stress measurement has been simulated to verify measurement feasibility and data reliability of the FBG strain sensor group.