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# Reply on RC2

Yimin Liu et al.

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Author comment on "Research on Fiber Bragg Grating Sensor Group for Three Dimensional In-situ Stress Measurement" by Yimin Liu et al., Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2021-14-AC2, 2021

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**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.