Dear reviewers

Thank you for your suggestions, all your suggestions are very important, and of guiding significance for our paper writing and research work. There are problems with the structure, experiment, expression, and language of the original manuscript, which do not reflect the idea of the manuscript well. Therefore, the following major adjustments were made:

1. The title was changed from ‘GNSS-based Displacement Detection Using Bayesian Inference for Deformation Monitoring’ to ‘Displacement Detection Based on Bayesian Inference from GNSS Kinematic Positioning for Deformation Monitoring’.
2. In the introduction section, many studies on deformation monitoring have been added.
3. The structure of the method section has been modified for better presentation and irrelevant content has been removed.
4. The number of observation satellites, GDOP, SNR, and multipath information has been added to analyze the experimental results in more detail.
5. All expressions in the manuscript have been checked for more rigorous presentation.

We have studied the reviewer’s comments carefully and have made revision which marked in red in the manuscript. We have tried our best to revise our manuscript according to the comments. Attached please find the revised version, which we would like to submit for your kind consideration.

----------------------------------------------------------------------------------------------------------------------

To Reviewer#1

**Comment 1**: First of all, the bibliography related to previous research of GNSS in deformation monitoring is not based on high quality previous studies. More specifically, there are experimental studies of Psimoulis (Psimoulis et al. 2008, Journal of Sound and Vibration, Psimoulis and Stiros, Computer-Aided and Civil Infrastructure Engineering, Psimoulis et al., 2018, Geophysical Journal International), Haberling (Haberling et al., 2016, Journal of Geodesy) and Moschas (Moschas et al., 2014 Earthquake Engineering and Structural Dynamics, Moschas and Stiros, 2015 GPS Solutions) related to the assessment of the accuracy of GNSS measurements for structural/dynamic motion monitoring, which should be cited. Also, studies of Xiaolin Meng and others (Gethin Roberts) related to bridge monitoring (Meng et al., 2018 Sensors, Meng et al, 2019 Remote Sensing, etc.). Regarding the application of lowcost GNSS receivers, apart from the studies of Gili et al., there is the study of Xue et al., 2021 (Journal of Applied Geomatics), which analyse more extensively the accuracy of low-cost GNSS receivers.

**Response**:

The bibliography related to previous research of GNSS in deformation monitoring has been restudied and summarized according to your comments. These contents have been added to the revised manuscript according to your suggestions.

Please refer to **lines 25-33, 38-53, 58-68** for detail.

**Comment 2**: There is a very thorough explanation about the Bayesian Inference method, the MCMC method and EKF method, which is very useful for readers who are not familiar who these methods. However, the EKF is presented for the explanation of how the GNSS data are processed. Since, the paper is not focused on that, but on the analysis of the GNSS timeseries, and the GNSS data are processed with RTK-Lib, there is no need to present EKF method.

**Response**:

Thank you for your constructive comments. The method section has been revised according to your comments. Descriptions of RTK and MCMC have been simplified and only the processing options related to them have been retained. The probability model for displacement detection has been kept and emphasized. In addition, the structure of this section has been reconstructed for better presentation.

**Comment 3**: The experiments are explained clearly and the application of the methodology is demonstrated. The GNSS time-series are known to be sensitive in long-period noise, mainly due to troposphere, ionosphere and multipath effects. The authors mention that the shortbaseline will limit the ionosphere/troposphere effect (but potentially not eliminate), while the multipath effect will remain. To my view, the GNSS time-series can be noisier, which could make even more challenging the identification of the displacement. The results seem realistic. However, the experiments could be more controllable in order to avoid potential vibration of the plank, which was not part of the experiment. The authors should check, whether these fluctuations of the GNSS time-series, which do not coincide with the applied displacement, are not the result of changes in the satellites constellation/geometry, cycle slips, etc. These are sources of errors of the GNSS data with similar characteristics (see Msaewe et al., 2018, Roberts et al., 2018, etc.).

**Response**:

The number of satellites, GDOP, SNR, multipath of observations have been added for checking the inconsistence according to your comments. Accordingly, Fig. 12 and Fig. 24 have been added to the revised manuscript.

Please refer to **Figs. 12, 24,** **lines 235-240, 288-290** for detail.

**Comment 4**: Furthermore, the authors only assess the proposed methodology on the vertical component, which generally is the least accurate of all the component of the GNSS data. It would be good to have a couple of tests for horizontal displacement, which can be potentially easier to control.

**Response**:

Thank you for your constructive comments. At present, our experimental device is too simple to flexibly provide horizontal direction control, especially reference displacement. I'm sorry I can't provide the experimental results in the horizontal direction, although the method should also be suitable in the horizontal direction.

In the manuscript, we supplemented the experimental scope involved in the work, which is the vertical direction.

Please refer to **lines 5, 299-300** for detail.

**Comment 5**: The manuscript needs improvement mainly in the justification of the results and the introduction. The topic is interesting, but further improvement is required, in order to be the material publishable.

**Response**:

The manuscript has been revised according to your comments. Please refer to the revised manuscript for detail.

----------------------------------------------------------------------------------------------------------------------

To Reviewer#2

**Comment 1**: Highlight is not expressed correctly. For example, "Displacement is an important parameter in engineering analysis" is just a background, not the focus of the article.

**Response**:

The highlight has been revised according to your suggestions:

* A displacement detection method based on Bayesian inference from GNSS kinematic positioning is presented.
* A new probability model of displacement detection is developted.
* Bayesian inference is implemented by Markov Chain Monte Carlo sampling
* Displacement detection is achieved by posterior samples of parameters

**Comment 2**: In the second section, the authors introduced some classical theories such as Bayesian inference and Monte Carlo algorithm. Is it necessary to expand them in detail? Instead of writing down all the theories, the authors' contribution should be emphasized.

**Response**:

This section has been revised according to your comment. Classical theories such as RTK and MCMC have been simplified and only the processing options related to them have been retained. The probability model for displacement detection has been kept and emphasized. In addition, the structure of this section has been reconstructed for better presentation.

**Comment 3**: Is Bayesian inference the first time used in GNSS based displacement detection? Compared with previous studies, what is the greatest benefit of using Bayesian inference? The authors should explain it in detail.

**Response**:

Thank you for your constructive comments. Related content has been added to the revised manuscript according to your comment. Please refer to **lines 294-299** for detail.

**Comment 4**: In the introduction, the author points out that there are more researches on long-term displacement detection based on GNSS, but less researches on short-term displacement detection based on GNSS. How does the authors define long-term and short-term? Is there any essential difference between the two detections? In my opinion, the data processing should not be fundamentally different.

**Response**:

Definitions of long-term and short-term displacement detection have been added according to your comments. Yes, as in your opinion, the data processing procedures of the two are the same. The main difference between the two is that the static positioning accuracy of GNSS is higher than that of kinematic positioning. The long-term periodic displacement detection focuses on the long-term seasonal displacement change, and the short-term displacement detection focuses on the real-time near real-time sudden displacement detection. Therefore, the displacement detection probability models used in Bayesian displacement detection are different.

Please refer to **lines 64-68** for detail.

**Comment 5**: The author proposes that the displacement can be determined in a short time by Bayesian inference. Compared with the previous method, how much faster is it? Clearer comparative results should be given.

**Response**:

The comparison and discussion between the proposed method and the index-based methods have been added according to your comments.

Please refer to **lines 191-199** for detail.

**Comment 6**: With respect to the displacement control platform proposed in Figure 7, what is the displacement control accuracy? Please provide more information.

**Response**:

Related content has been added to the revised manuscript according to your comment. ‘The minimum scale of the tape is 1 mm, that is, the accuracy of the tape is 1 mm, and the estimated reading is 0.1 mm. Take five readings for each measurement to ensure the accuracy and reliability of the data.’

Please refer to **lines 207-209** for detail.

**Comment 7**: The expression should be improved.

**Response**:

The manuscript has been revised according to your comments. Please refer totherevised manuscript for detail.

**Thank you again for your advice and hope to learn more from you.**

**Best wishes.**