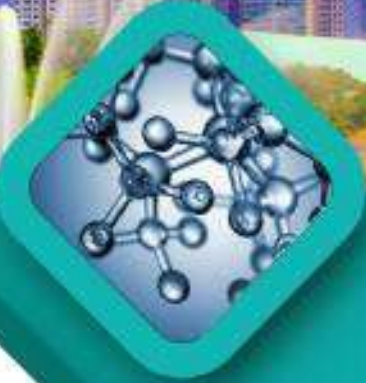


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PREFACE

The 3rd International Conference on Science, Engineering and Social Sciences, ICSESS'17 is organised jointly by Universiti Teknologi Malaysia (UTM), International Student Society-Nigeria (ISS-Nigeria), UTM International and International Student Center (ISC). The theme for this year conference is "*Promoting Innovative Multidisciplinary Research for Sustainable Development*". This promotes and encourage innovative and novelty for sustainable development in wide range of science, engineering, social science researches in terms of approaches and methods, advanced technology, professionalization, experiences, and culture.

The responses from participants for this conference is overwhelming, well attended, and successful. Our participants are from Universiti Teknologi Malaysia (UTM), School of Business, Yogyakarta, Indonesia, Universiti Tun Hussein Onn Malaysia (UTHM), University Andalas, Kampus UNAND Limau Manih, Padang, West Sumatera, Indonesia, Universiti Teknologi Mara (UITM), University of Jos Nigeria, Federal University of Technology Minna Nigeria (FUTMINNA), University of Dammam Saudi Arabia just to mention a few. Hence, this conference provides a good platform for professionals, academicians and researchers to widen their knowledge and approach on latest advances in research and innovation. Papers presented in these conference cover a wide spectrum of science, engineering and social sciences.

Finally, a note of thanks must go to ICSESS'17 central working committee for their remarkable dedication in making these conference a success. We hope the event will prove to be an inspiring experience to all committee members and participants.

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Effect of Noise and Measurement Distance on Wavelet Transform-Based Damage Detection

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ABSTRACT

Wavelet Transform (WT) has been proven to be a reliable method of damage detection in structures. This is partly due to its ability to detect local damage. However, the effect of noise may result to false detection of damage, thus affecting the reliability of the method. Moreover, the location of sensors also plays an important role in providing good quality dynamic response data of structure, where a small number of sensors may lead to inadequate data for accurate estimation of the structural damage, while a large number increases the financial cost of the monitoring system and causes higher computational time. In this view, this study investigates the effect of noise and different sensor distance to Continuous Wavelet Transform (CWT) for damage detection through the decomposition of mode shape differences. In this study, a numerical model of a plate with all four sides fixed is used as an example. To analyse the noise effect, various noise levels are added to the mode shape difference signal before decomposition. The effect of the sensor distance is done by using different sensor measuring distances. The results indicate that the increase of noise reduced the detectability of damage. It is also observed that excessive sensor distance increment significantly effects damage detectability.

Keywords: Plate, Wavelet Transform, Damage detection, Noise, Measurement Distance

INTRODUCTION

The distance between the sensors may also influence the degree of accuracy of damage identification (Vafaei and Alih, 2015). When the number of sensors is small, the distance between sensor are larger, thus lead to less accurate estimation of the structural damage, while a large number increases the financial cost of the monitoring system and causes higher computational time (Saïd and Djamel, 2013). However, study on the effect of different sensor distance to damage detectability focusing on WT method is quite limited. Therefore, this study investigates the sensitivity of CWT to noise and sensor's measurement distance for damage detection in a plate-like structure. For the purpose of damage detection, the mode shape difference before and after damage served as the input rather than conventional mode shape of the damaged structure (Lee *et al.*, 2005). The vibration data obtained from the numerical analysis of the plate structure is used in computing the mode shape difference. To detect and locate the damage, the mode shape differences are then decomposed using CWT. The effect of noise and sensors' distances to CWT in detection of different degrees of damage severity in a plate structure is analysed in this study. To study the effect of noise to damage detectability, various levels of noise are added to the values of the mode shape differences. The effect of the sensor distance is investigated by varying the distance between the measurement nodes. The effects of noise and sensor distance are evaluated based on damage detectability by applying a damage index and pictorial representation of the decomposed signal.

MAIN RESULTS

Figure 1 summarises the result (middle and side damages) for i_5 with noise level varying from 1% to 10%, and damage severity from 5% to 87.5%. When the noise level increases (and damage severity decreases), it is observed that the sensitivity to damage decreases. Take figure 13(a) for example (middle damage), when noise is increased (to 2%, 5% or 10%), damage is not detectable until the severity is up to 25%. Also, when the damage severity is 12.5%, damage is detectable when the noise is reduced to 1%. The reason for this is that the sensitive damage features in the data have been submerged by noise. It is also observed that the accuracy of the detectability is high, close to 100%, and on the other hand, the non-detected damages are completely undetectable.

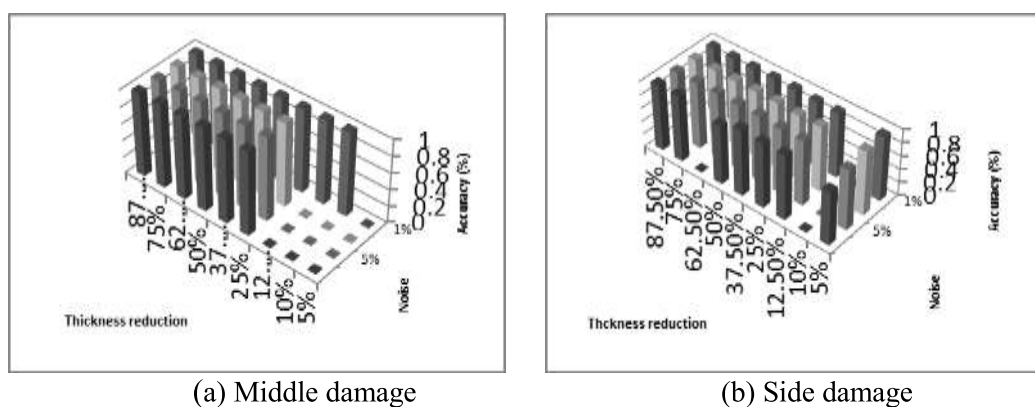


Figure 1. Measurement at 5mm (i_5)

CONCLUSION

The study presents an investigation on the Wavelet Transform (WT) sensitivity and attributed uncertainties for damage detection of plate-type structures using mode shape difference. The results have shown the sensitivity of WT to damage and its ability to accurately detect damage in the presence of noise. It is observed that damage is either detected accurately or it's not detected at all. For all studied cases, damage was not detectable when the measurement distance was 80mm. In most cases, the presence of noise, increment of measurement distance and decrease of damage severity reduced the detectability of damage. Measurements at i_5 , i_{10} , i_{20} and i_{40} are adequate for mode shape difference analysing with WT for damage detection.

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