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Vibration modelling and structural modification of combine harvester thresher using operational modal analysis and finite element method

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Abstract. In present study, Operational Modal Analysis (OMA) was employed to carry out the dynamic and vibration analysis of the threshing unit of the combine harvester thresher as a mechanical component. The main study is to find the causes of vibration and to decrease it to enhance the lifetime and efficiency of the threshing unit. By utilizing OMA, structural modal parameters such as mode shapes, natural frequencies, and damping ratio was calculated. The combine harvester was excited by engine to vibrate different parts and accelerometer sensor collected acceleration signals at different speeds, and OMA was utilized by nonparametric and frequency analysis methods to obtain modal parameters while vibrating in real working conditions. Afterwards, finite element model was designed from the thresher and updated using the data obtained from the modal analysis. Using the conducted analyses, it was specified that proximity of the thresher pass frequency to one of the natural frequencies (16.64 Hz) was the most important effect of vibration in the thresher. Modification process of the structure was carried out by increasing mass required for changing the natural frequency location of the first mode to 12.4 Hz in order to reduce resonance and vibration of the thresher.

Keywords: structural modification; operational modal analysis; vibrations; thresher

1. Introduction

An important process in grain harvesting with combine harvester is threshing the materials using the thresher. An ideal thresher is one carries out complete threshing with maximum input crop and best grain separation while saves the shape and quality of the grain and minimizes grain loss Miu (2004). The distance between the threshing drum and the concave and the rotational speed of the threshing drum are among effective factors in design, performance, and failure of the threshing drum in a combine harvester. Vibration in the threshing drum causes the distance between the threshing drum and the concave to change, leading to an increase in threshing drum failure.

Vibrations of this unit cause the threshing action to fail and combine harvester loss to increase;

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