Vibration Analysis of shadowmask using measured acceleration at stud pin

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Abstract

Harmonic analysis, based on finite element method, is popularly used to predict a response of shadow mask to the external excitation from speakers. Since vibration wave travels from speakers to the shadow mask, a finite element model must include all mechanical parts between the speakers and the shadow mask, which increases total time needed in finite element modeling and computation.

In this paper, we perform the harmonic analysis on a MF assembly to obtain frequency response function of a shadow mask, and compare the solutions with experimental results.

1. Introduction

When TV is on, sound pressure from a speaker excites a Cathode-Ray tube (CRT), and results in vibration of mechanical parts such as a shadowmask and other support parts.

The shadowmask is a thin curved plate with many micro-level holes, which control electron beams to reach to a proper position of the fluorescent.

Vibration of a shadowmask, results in miss-landing of electron beams, and it deteriorates quality of screen image as shown in Figure 1.

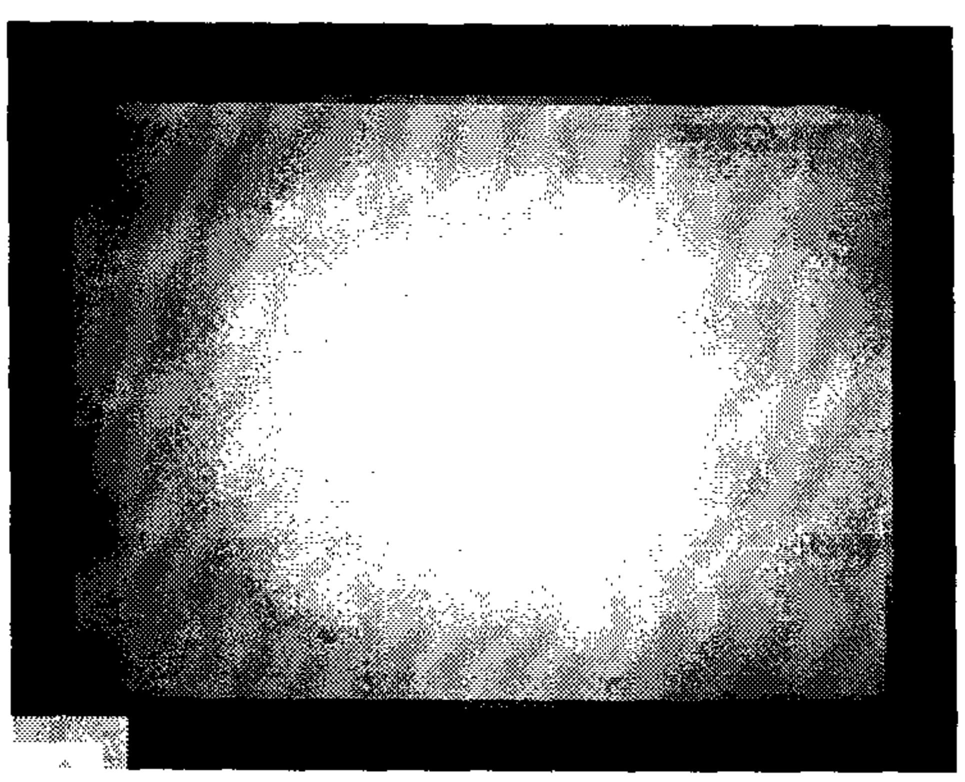

Figure 1 Microphonic phenomenon resulted from vibration of a shadowmask

In recent CRT industry, one of big issues is the flatness of CRT, and this makes the shadowmask to have low curvatures. Thus, vibration of the shadowmask is being realized a critical problem in developing a flat CRT.

In this paper, only the mechanical parts (MFS assembly), which consist of springs, a frame and a shadowmask, are considered in finite element analysis to predict the response of the shadowmask to the excitation of speakers. Instead of ignoring other parts like the panel, funnel and ears, acceleration is measured at the stud pins where the springs and the panel meet together, and this acceleration is applied to the finite element model under consideration.

In the way, lots of time is required in finite element modeling and solution.

2. Experiment

A brief description of the experiment to obtain frequency response function (FRF) of the acceleration at a stud pin is given as follows.

First, a PM assembly, which consists of a panel, springs, a frame and a shadowmask, is mounted on a specially manufactured vacuum machine.

A point of front panel is excited by pseudo random force in 0 ~ 400Hz frequency ranges, and the acceleration at a stud pin and amplitude at a point of shadowmask are measured, respectively. The measured acceleration at the stud pin will be used for later analysis. In this paper, Pulse System manufactured by B&K is used for measurement and signal process.

3. Finite Element Analysis

Steady state dynamics is cost effective tool to get a vibration response in ABAQUS, because it is a mode base liner analysis.

Vibration analysis of MFS assembly is as follows.

First, MFS assembly is discretized to get finite element model. The other parts of CRTs, such as a panel and a funnel, are ignored in this analysis for fast geometric modelling and computation.

In steady state dynamic analysis, it is impossible to consider non-linear behaviour such as contact between the skirt of shadowmask and the frame, so the region in which contact occurs is constrained by suitable displacement boundary conditions.

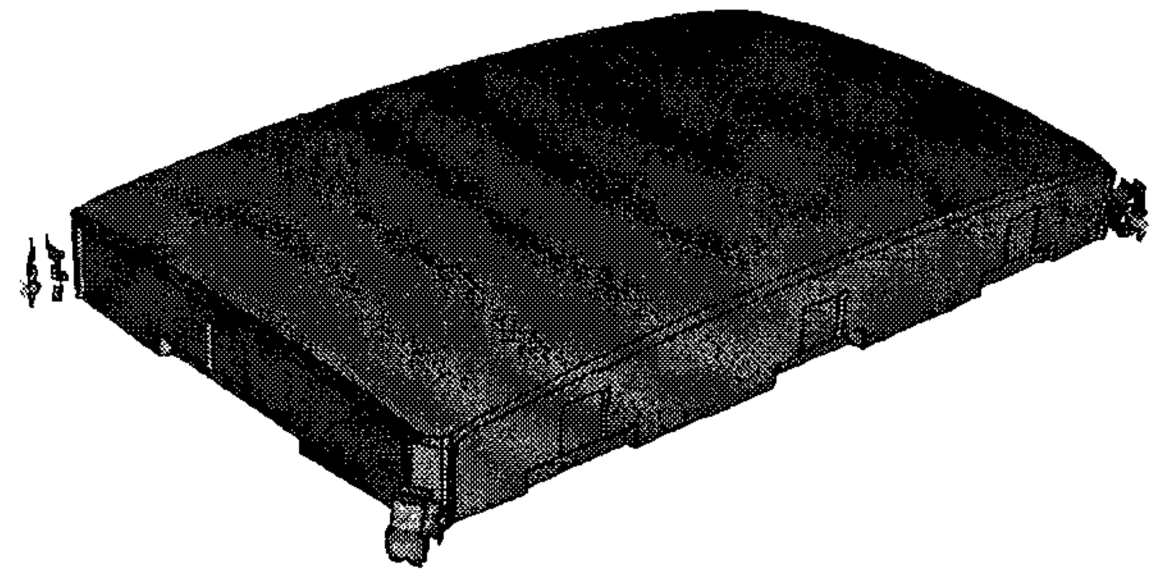

Figure 2 Finite Element Model of MFS Assembly

Second, the MFS assembly is inserted in a panel by applying proper forces to springs. Next, modal analysis is performed on this pre-stressed finite element model.

Finally, the acceleration measured at the stud pin is applied to the springs to get the response of the shadowmask.

4. Results

Figure 3 shows a FRF of measured acceleration at stud-pin.

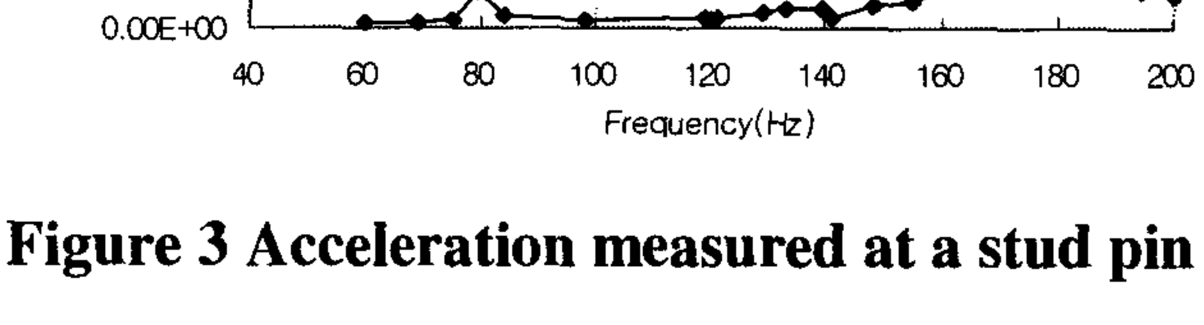

Figure 3 Acceleration measured at a stud pin

Figure 4 is the corresponding FRF diagram that measured at a point of shadowmask, where resonance of shadowmask occurs at several frequencies.

Figure 5 is the FRF of acceleration of the shadowmask through finite element analysis, which shows a good approximation to the experimental results shown in Figure 4.

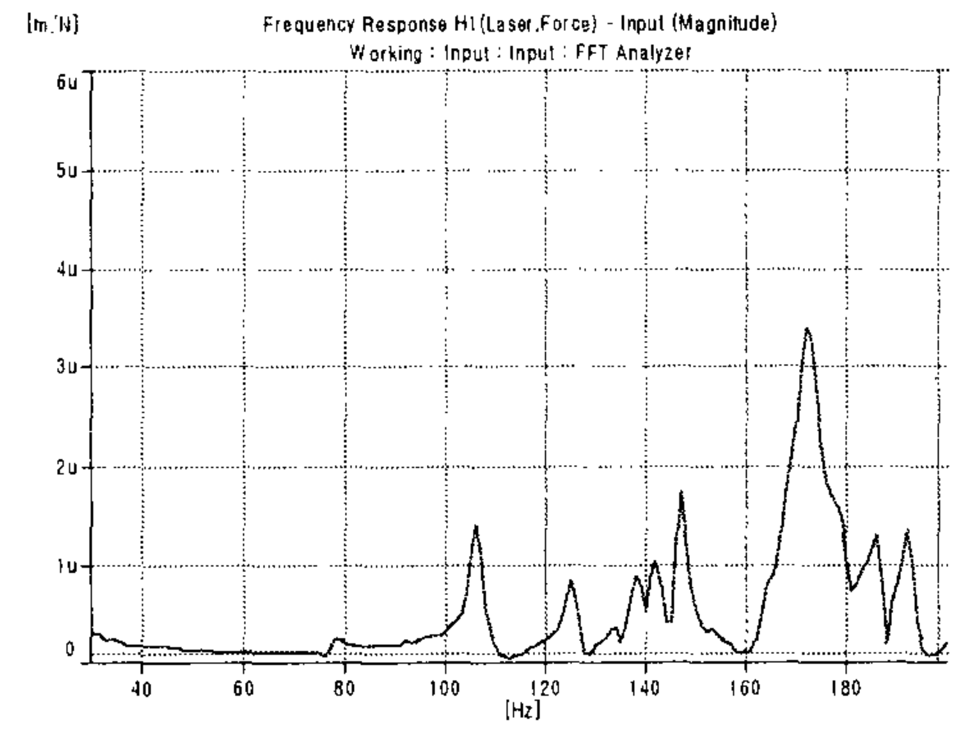

Figure 4 FRF of measured acceleration of a shadowmask

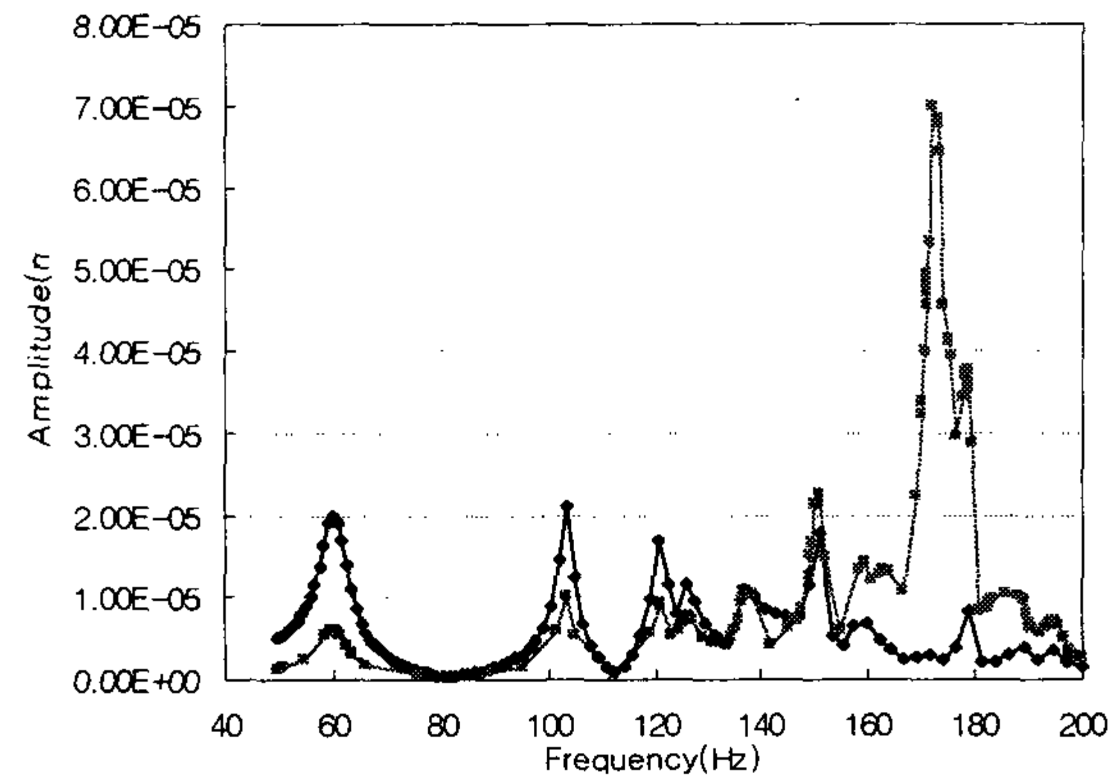

Fig.5 FRF of acceleration of a shadowmask obtained by finite element analysis

5. Conclusion

In this paper, the MFS assembly is used to get the response of the shadowmask to external excitation applied on the panel. By using the measured acceleration at stud pins, it is not necessary to model the whole CRT.

The computed results are verified by experimental signal, which shows a good prediction of the vibration response of the shadowmask.

6. References

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