

## Vibration Analysis and Optimization Design of Ultrasonic Horn

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**Abstract :** Ultrasonic horn has the functions of amplifying amplitude and reducing resonant impedance in ultrasonic system. Its primary function is to amplify deformation or velocity during vibration and focus ultrasonic energy on the small area. It is a crucial component in design of ultrasonic vibration system. There are five common design methods for ultrasonic horns: analytical method, equivalent circuit method, equal mechanical impedance, transfer matrix method, finite element method. In addition, the general optimization design process is to change the geometric parameters to improve a single performance. Therefore, in the general optimization design process, we couldn't find the relation of parameter and objective. However, a good optimization design must be able to establish the relationship between input parameters and output parameters so that the designer can choose between parameters according to different performance objectives and obtain the results of the optimization design. In this study, an ultrasonic horn provided by Maxwide Ultrasonic co., Ltd. was used as the contrast of optimized ultrasonic horn. The ANSYS finite element analysis (FEA) software was used to simulate the distribution of the horn amplitudes and the natural frequency value. The results showed that the frequency for the simulation values and actual measurement values were similar, verifying the accuracy of the simulation values. The ANSYS DesignXplorer was used to perform Response Surface optimization, which could shows the relation of parameter and objective. Therefore, this method can be used to substitute the traditional experience method or the trial-and-error method for design to reduce material costs and design cycles.

**Keywords :** horn, natural frequency, response surface optimization, ultrasonic vibration

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