Acoustical Design of Stethoscope for Improved Performance

C. Thiagarajan[1], Gururajan R.[2], A. H. Baig[2], Prema S.[3]

[1]ATOA Scientific Technologies Pvt Ltd, Whitefield, Bangalore, Karnataka India.
[2]University of Southern Queensland, Toowoomba Qld 4350, Australia.
[3]RMK Engineering College, Chennai, Tamil Nadu, India

Abstract

Stethoscope is in use for more than 200 years for medical diagnostics, especially for auscultation. Recently, the unprecedented growth in mobile technology revived the use of stethoscope for Telehealthcare. Digital or electronic stethoscopes are increasingly researched for use in Telehealthcare. This paper mainly focuses on the acoustical and multiphysics design aspects of the stethoscope for improved acoustical performance. A COMSOL Multiphysics model of the stethoscope chest piece was developed. The model was setup to investigate the effect of diaphragm, shape of the chest piece, stem and acoustic tube. The sound transmission efficiency of the components will be investigated with multiphysics models by coupling the acoustical and structural performance. The effect of ambient noise on the performance will also be studied and reported. Figure 1 shows the CAD model, FEA mesh and typical acoustical pressure results. Figure 2 shows the effect of noise level on the performance of the stethoscope. This model will be further used to investigate the effects of shape, size and material parameters on the performance and improvement in the acoustic transmission and noise isolation. The frequency response (Figure 3) of the system will also be investigated for resonance and performance in relation to auscultation of cardio, lung and other sounds. The ultimate objective is leverage the improvement in the acoustics of stethoscope for use in Telehealthcare.
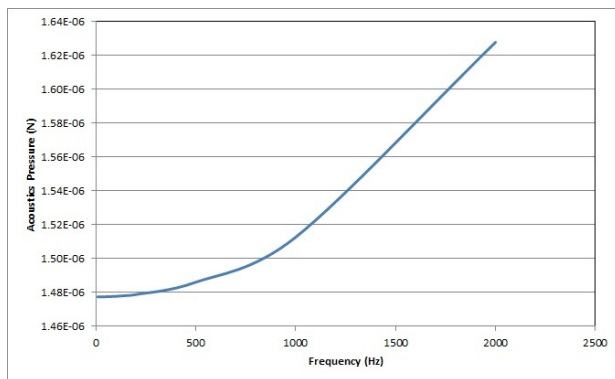
Figures used in the abstract
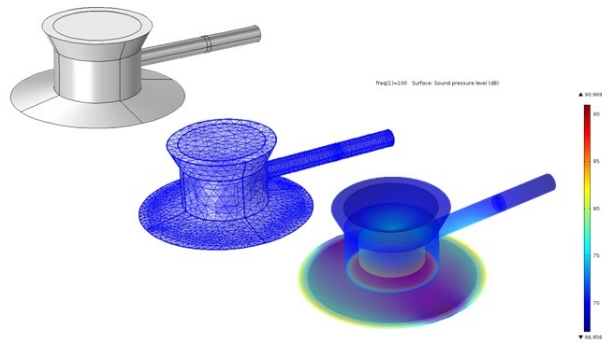
Figure 1: Typical CAD, FEA model and acoustics pressure results on a stethoscope.
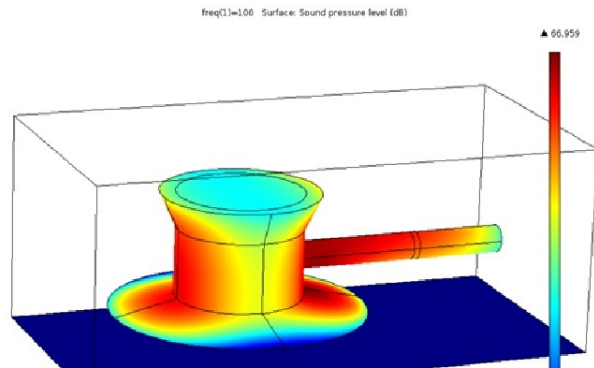
Figure 2: Typical effect of ambient noise on the performance of stethoscope.

Figure 3: Typical acoustic frequency responses.