Design optimization of double-chamber mufflers on constrained venting system by GA method

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Whilst the space volume of mufflers in a noise control system is often constrained for maintenance in practical engineering work, the maximization on muffler’s performance becomes important and essential. To efficiently depress the venting noise, a high performance of double-chamber muffler is then proposed and investigated in this paper. To assess the optimal solution in the muffler design, the genetic algorithm (GA), a stochastic algorithm, is also applied, accordingly.

This paper presents the GA application for the size optimal design of double-chamber muffler under space constraints and dealing with broadband noise. Using technique of four-pole matrix for sound transmission loss (STL) calculation in conjunction with the GA technique, the optimisation was carried out.

Before GA operation, a single-chamber muffler is simulated and compared with the experimental data for accuracy check of mathematical model. Thereafter, a simple program of noise control at the pure tone of 500 Hz has been pre-run to verify the correctness of genetic algorithm before the optimal design of broadband noise was performed. Results show that both the accuracy of mathematical model and the correctness of GA method are acceptable. Consequently, the GA optimization on double-chamber muffler proposed in this study may provide a quick and correct approach.

Keywords: double-chamber muffler; four-pole matrix method; sound transmission loss; space constraints; GA optimization

INTRODUCTION

As high noise levels can be harmful to workers and can lead not only to psychological but also physiological ailment, the attention of noise control on equipment is then focused gradually. To eliminate the noise value of venting system, muffler is habitually in use [1]. However, the space of muffler is often limited as required by operation and maintenance. And even if many researches of muffler designs have been well addressed, the discussion of optimal design under space constraints is rarely emphasized. In the previous work by Yeh et al. [2], the graphical analysis of optimal shape design to improve the performance of sound transmission loss (STL) on a constrained single expansion muffler was discussed.

To efficiently depress the noise emitted from venting system, the sizing optimization of constrained double-chamber muffler with extended tubes by mathematical gradient methods

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