Computer Aided Design on Single Expansion Muffler with Extended Tube under Space Constraints

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Abstract

The optimization approach of maximal STL (sound transmission loss) and muffler dimension under space constraints within a building or machine room is fully addressed throughout the graphic analyses as well as the computer-aided numerical assessments in this paper. The primary set of design data is derived by the computer graphic analysis on sensitivity, and the successive algorithm of iteration techniques based on the initial design data is then carried out individually. These results are moreover compared with each other for the accuracy purpose. The theoretical and simulated results are found in good agreements. The optimal approach on the design of single expansion muffler with extended tube proposed in this study surely provides a quick and economical procedure to optimize the single expansion muffler with the maximal sound transmission loss under space limitations without redundant testing.


1. Introduction

Whilst the muffler dimension is often limited inside a building or machine room, the consideration of maximal sound transmission loss (STL) under space constraints becomes important and essential to the field of acoustics. Many researches of muffler design have been well addressed; however, the discussion of sensitivity among design parameters under space constraints is rarely emphasized. Bernhard [1] has introduced the shape optimization of simple expansion mufflers by using design sensitivity matrices. The space volume of the reactive silencer is still non-constrained, and the calculation of design sensitivity matrices is difficult especially for the mufflers, which are complicated. In the previous work [2], the optimal shape design to improve the performance of STL on a single expansion muffler was discussed. To increase the STL on the muffler, a new muffler with extended tube is thus introduced and discussed in this paper.

The trial and error method in the improvement of muffler design is considered tedious and expensive in optimizing the dimension of a muffler inside the machine room that is often limited by the space constraint. Therefore, the interest to optimize STL of the absorber under space constraints is arising in the field. This paper provides a quick method to obtain an optimal design data on a muffler by using computer graphic system and numerical assessment. A numerical case of a muffler with extended tube is also fully illustrated in the paper. Furthermore, a plane wave theorem is applied for the derivation of STL by confining the shape of each tube to be slender discussed by Munjal [3].

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