GA optimization on muffler with side inlet/outlet under space constraints

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Considering the prerequisite of operation and maintenance in an existing machine room, the available space of muffler is then occasionally limited. The issue to maximize the acoustic performance in muffler by using shape optimization method is presented. To overwhelm prohibitive numerical complexity of the problem, we have applied here a genetic algorithm (GA). A numerical case dealing with the elimination of pure tone noise is introduced. Before GA optimization, one example is tested for accuracy check of the mathematical model. Consequently, the result shows that the predicted sound transmission loss ($STL$) is maximized exactly at desired frequency.

Key words: GA optimization, muffler with side inlet/outlet tube, four-pole matrix

Nomenclature

- $bit_{n}$: bit length
- $c_{o}$: sound speed [$m s^{-1}$]
- $D$: diameter [m]
- elt_no: selection of elite [1 for yes and 0 for no]
- gen_no: maximum no. of generation
- $j$: $\sqrt{-1}$
- $k$: wave number
- $k_{e}$, $k_{c}$: stagnation pressure loss factors
- $L_{i}$: length [m]
- $M_{i}$: $V_{i}/c_{o}$, Mach number at $i$
- $p_{i}$: pressure; acoustic pressure at $i$ [Pa]
- $p_{c,i}$: aeroacoustic pressure at $i$ [Pa]
- $pc$: crossover ratio
- $pm$: mutation ratio
- popuSize: no. of population
- $S_{i}$: section area at $i$ [m$^2$]
- $STL$: sound transmission loss [dB]
- $u_{i}$: acoustic particle velocity at $i$ [m $s^{-1}$]
- $V_{i}$: mean flow velocity at $i$ [m $s^{-1}$]
- $\nu_{c,i}$: aeroacoustic mass velocity at $i$ [kg $s^{-1}$]
- $\nu_{i}$: acoustic mass velocity at $i$ [kg $s^{-1}$]
- $Y_{i}$: characteristic impedance at $i$
- $Z_{i}$: impedance at $i$
- $\rho_{0}$: air density [kg m$^{-3}$]

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