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LETTERS TO THE EDITOR

COMMENTS ON "SOUND PROPAGATION IN AN ANNULAR DUCT WITH MEAN POTENTIAL SWIRLING FLOW"

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The writers wish to congratulate the authors of reference [1] on their important and useful contribution. In particular, their asymptotic method for analysing the propagation of pressure disturbances in an annular duct with mean potential axial and swirling flow deserves special attention.

It is the purpose of this discussion to point out some errata which, apparently, have been inadvertently committed by the authors.

First of all, we note that the expression for $\tilde{\omega}$ (see reference [1, p. 606]) is not correct. Instead, this expression must be written as, $\tilde{\omega} = (\omega/c_0) - (mM_s/r_m)$, where ω is the frequency, c_0 is the speed of sound of the mean flow, M_s is the swirl Mach number, r_m is the mean radius of the annulus, and m is the integer modal number characterizing the circumferential eigenmodes.

Further, we consider the asymptotic solution for the eigenvalues k_{mn} obtained by the authors of reference [1] for $M_0 = 0{\cdot}7$, $M_s = 0{\cdot}5$, $\bar{\omega} = 15$, $m = 5$, $n = 4$, where M_0 is the axial Mach number, $\bar{\omega} = \omega r_m/\bar{c}_0$, $\bar{c}_0$ is the stagnation speed of sound; n is the integer modal number characterizing the radial eigenmodes (see reference [1, p. 611, Table 1]).

As can be seen in Table 1 for the above mentioned parameters Re(k) is equal to $-19{\cdot}022$. Then taking into account that in reference [1] the results for the eigenvalues are normalized with respect to the mean radius of the annulus r_m, from equation (27) of reference [1] one derives

$$-19{\cdot}022 = \mathrm{Re}(k_{mn}r_m) = \mathrm{Re}\left\{\frac{1}{\beta_0^2}\left[-M_0(\tilde{\omega}r_m) \pm \left\{(\tilde{\omega}r_m)^2 - \beta_0^2\left(m^2 + \frac{n^2\pi^2 r_m^2}{(r_t - r_h)^2}\right)\right\}^{1/2}\right]\right\}, \qquad (1)$$

where $\beta_0^2 = 1 - \mathrm{M}_0^2$.

Since the annulus used by Golubev and Atassi in the numerical calculations has tip and hub radii $r_t = 6$ and $r_h = 4$, respectively, then from equation (1) one obtains

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$(\tilde{\omega} r_m) = 19{\cdot}022\beta_0^2/M_0 = 13{\cdot}859$, and

$$\mathrm{Im}(k_{mn} r_m) = -\frac{1}{\beta_0^2}\left|(\tilde{\omega} r_m)^2 - \beta_0^2\left(m^2 + \frac{n^2\pi^2 r_m^2}{(r_t - r_h)^2}\right)\right|^{1/2}$$

$$= -\frac{1}{0{\cdot}51}\left|(13{\cdot}859)^2 - 0{\cdot}51\left(5^2 + \frac{4^2\pi^2 5^2}{2^2}\right)\right|^{1/2} = -35{\cdot}296.$$

This result is in contrast to that of the asymptotic solution of reference [1], which predicts $\mathrm{Im}(k_{mn} r_m) = -22{\cdot}286$.

Similar results are obtained for all $n = 5, \ldots, 10$ corresponding to $m = \pm 5$.

REFERENCE

1. V. V. Golubev and H. M. Atassi 1996 *Journal of Sound and Vibration* **198**, 601–616. Sound propagation in an annular duct with mean potential swirling flow.