Discussion

Exact solutions for the longitudinal vibration of non-uniform rods [J. Sound Vib. 207 (1997) 721–729]

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The aims of this communication are to correct the frequency equation for a free–free rod with area variation $A(x)=A_0\sin^2(ax+b)$ in a published article [1] and present the corrected non-dimensional natural frequencies.

Substituting the expression for the displacement of the rod given by Eq. (33) in Ref. [1] into the free–free boundary conditions gives the frequency equation

$$\tan(kL) = ak[\cot(b)-\cot(aL+b)]/[k^2+a^2\cot(b)\cot(aL+b)] \tag{1}$$

where $k^2 = \rho\omega^2/E+a^2$. This is different from Eq. (37) in [1] which we believe is incorrect.

The non-dimensional natural frequencies ($\beta L = \omega\sqrt{\rho/EL}$) found by solving the corrected frequency equation are given in Table 1 together with the results of Kumar and Sujith [1] for comparison. This shows that the results in Table 6 of [1] are also incorrect. Although not relevant now, the results in Table 6 do not agree even with Eq. (37) in [1].

In Ref. [1], as pointed out by an anonymous reviewer, there is also a misprint in Eq. (34) where the coefficient associated with $J_{-1/2}$ should have been c_2 not c_1. We also note that while $J_{1/2}$ has been defined by Eq. (18), $J_{-1/2}$ has not been defined, but it appears that the correct formula had been used.

Table 1
Comparison of non-dimensional natural frequencies for various values of a ($L=1$, $b=1$).

Mode	$a=1$ [1]	$a=1$ Present	$a=2$ [1]	$a=2$ Present
1	3.0004297	3.309070	1.5808147	4.209604
2	6.216901	6.375209	5.113309	7.259860
3	9.380888	9.487363	8.436760	10.283498
4	12.533530	12.613648	11.721540	13.317980
5	15.681720	15.745913	14.977670	16.368917
6	18.827700	18.881240	18.210650	19.435335

Reference

[1] B.M. Kumar, R.I. Sujith, Exact solutions for the longitudinal vibration of non-uniform rods, *Journal of Sound and Vibration* 207 (5) (1997) 721–729.

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