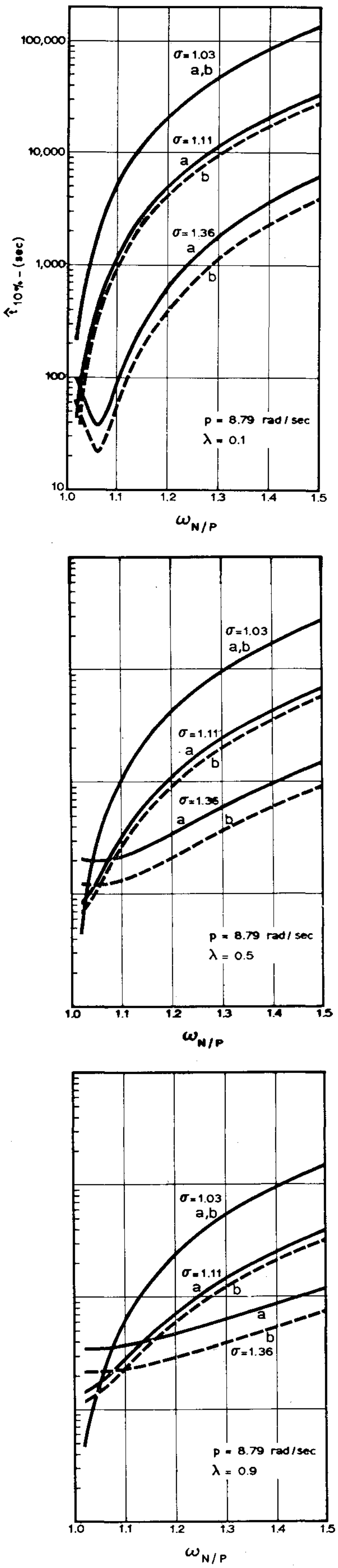

Fig. 1 Computer solution for damping times: $ma^2/Iy = 6.46 \times 10^{-4}$ $p = 8.79$ rad/sec; a) previous results and b) new results.

It can be shown that this set of equations satisfies the principle of conservation of angular momentum of the system consisting of the satellite body and the sliding mass, i.e.,

$$\{p(I_x + my^2) - mayq\}^2 + \{q(I_y + ma^2) - mayp\}^2 + \{r(I_z + ma^2 + my^2) + ma\dot{y}\}^2 = \text{const}$$

The present set of equations is far more complex than the one treated in the reference. In order to get an estimate of the importance of the differences between the two sets of equations, the present set is linearized and the resulting characteristic equation is solved to yield $t_{10\%}$ (the time required to damp to 10%). The results for the case, where $p = 8.79$ rad/sec, are shown in Fig. 1. The solid lines represent the values taken from the reference, and the dashed lines represent the values obtained from the present equations.

Although differences of up to 40% occur, it is seen that the general shape of the curves is not affected. In particular, the location of the optimum has not changed. It is interesting to note that the difference increases with increasing ratio of moments of inertia, but is independent of the damping coefficient.

No attempt has been made to evaluate the effect of the nonlinear terms in the complete equations.

Reference

[1] Wadleigh, K. H., Galloway, A. J., and Mathur, P. N., "Spinning vehicle nutation damper," J. Spacecraft Rockets **1**, 588–592 (1964).

Reply by Authors to E. J. Slachmuylders

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The foregoing Technical Comment discusses a more rigorous and complete set of equations of motion than were used in arriving at the computed curves of Ref. (1). This was pointed out also in private correspondence by P. C. Wheeler of Stanford Electronics Laboratories, Stanford, Calif. Linearization of the complete equations results in the same set of equations of motion with the exception of an added term in the second equation of the set at the bottom of p. 589 of Ref. (1) as follows (the added term is enclosed in square brackets):

$$\dot{q} + \Omega r - [(2\,\text{map}/I_y)\dot{y}] = 0$$

When this term is included in the determinant expansion to obtain the characteristic function, a term is added to the coefficient of s^2 leaving the coefficients of s^3 and s (which contain the damping factor λ) unaffected.

A calculation, including the enclosed term, gave a time to damp some 30% less than the curve value with $p = 18.8$ rad/sec, $\lambda = 0.5$, $\sigma = 1.36$, and $\omega_n/p = 1.10$.

Likely, the error caused by omission of the term is of the order of magnitude of other errors in the system caused by linearization. However, the authors are indebted to E. J. Slachmuylders and P. C. Wheeler for pointing out the complete equations.

References

[1] Wadleigh, K. H., Galloway, A. J., and Mathur, P. N., "Spinning vehicle nutation damper," J. Spacecraft Rockets **1**, 588–592 (1964).

Received April 2, 1965.
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