[6] Dixon, S. C. and Hudson, M. L., "Flutter, Vibration and Buckling of Truncated Orthotropic Conical Shells with Generalized Elastic Edge Restraint," NASA TN D-5759, 1970.

[7] Adelman, H. M., Catherines, D. S., and Walton, W. C., Jr., "A Method for Computation of Vibration Modes and Frequencies of Orthotropic Thin Shells of Revolution Having General Meridional Curvature," NASA TN D-4972, 1969.

AIAA 81-4044

# Reply by Authors to T. Ueda and S. Kobayashi

Maher N. Bismarck-Nasr*
*Embraer, Empresa Brasileira de Aeronāutica S. A., São Josē dos Campos, Brazil*
and
Hely R. Costa Savio†
*Instituto de Atividades Espaciais, São Josē dos Campos, Brazil*

WE wish to thank T. Ueda and S. Kobayashi for their interesting comments and for their interest in our work. The object of this reply is to clarify some points they have raised.

1) Due to space limitation only a few of the cases studied were reported in our Note.[1] However, more than ten cases were studied in a comprehensive way, including the 120 deg cone free-vibration analysis reported by Ueda and Kobayashi.

Received Aug. 6, 1980.

*Assessor of Advanced Methods. Member AIAA.
†Engineer.

**Table 1 Natural frequencies of a 120 deg conical frustum, Hz**

| | Ref. 2 | Present analysis | | |
|---|---|---|---|---|
| $n$ | 10 elements | 6 elements | 12 elements | 20 elements |
| 1 | 96.87 | 100.35 | 96.83 | 95.97 |
| 2 | 42.87 | 47.51 | 43.18 | 42.21 |
| 3 | 23.96 | 29.78 | 24.91 | 23.89 |
| 4 | 18.62 | 24.13 | 19.70 | 18.85 |
| 5 | 21.14 | 24.80 | 21.79 | 21.33 |
| 6 | 26.88 | 29.00 | 27.21 | 26.98 |

Our results for this case are reported in Table 1 and are compared with those of Ref. 2 where the geometric and material data of the shell are given.

2) For the flutter case studied, Novozhilov's shell theory shows that the simplified Mushtari-Donnell theory used by the commenters is in error by 5-10% in the frequencies calculated and it may be greater for other shell geometry and $n$ as stated in our Note.

3) The neglect of the in-plane inertias can lead to errors up to 40% in the frequencies calculations, e. g., see Ref. 3.

4) The commenters claim to use a static condensation for the flutter problem. However, this cannot be accepted as a rule of thumb, especially for the complicated problem treated here, since it lacks rationalization. Further, it depends on intuition and can lead to erroneous results, as the commenters themselves state in their work.[4]

## References

[1] Bismarck-Nasr, M. N. and Costa Savio, H. R., "Finite-Element Solution of the Supersonic Flutter of Conical Shells," *AIAA Journal*, Vol. 17, Oct. 1979, pp. 1148-1150.

[2] Adelman, H. M., Catherines, D. S., and Walton, W. C. Jr., "A Method for Computation of Vibration Modes and Frequencies of Orthotropic Thin Shells of Revolution Having General Meridional Curvature," NASA TN D-4972, 1969.

[3] Leissa, A. W., "Vibrations of Shells," NASA SP-288, 1973.

[4] Ueda, T., Kobayashi, S., and Kihira, M., "Supersonic Flutter of Truncated Conical Shells," *Transactions of the Japan Society for Aeronautical and Space Sciences*, Vol. 20, No. 47, 1977, pp. 13-30.