

frequencies. Continued research along the lines recently proposed by Chen and Garba<sup>8</sup> would appear to be appropriate if any further progress is to be made in structural system identification. Orthogonality exercises seem to have led us nowhere.

### Acknowledgment

The author wishes to acknowledge J. A. McGrew of the Douglas Aircraft Co., Long Beach, Calif., for assistance in calculating the results presented in Tables 1-3.

### References

- <sup>1</sup>Baruch, M., "Proportional Optimal Orthogonalization of Measured Modes," *AIAA Journal*, Vol. 18, July 1980, pp. 859-861.
- <sup>2</sup>Kordes, E. E., Kruszewski, E. T., and Weidman, D. J., "Experimental Influence Coefficients and Vibration Modes of a Built-up 45° Delta-wing Specimen," NACA TN 3999, May 1957.
- <sup>3</sup>Targoff, W. P., "Orthogonality Check and Correction of Measured Modes," *AIAA Journal*, Vol. 14, Feb. 1976, pp. 164-167.
- <sup>4</sup>Rodden, W. P., "Comment on 'Orthogonality Check and Correction of Measured Modes'," *AIAA Journal*, Vol. 15, July 1977, p. 1054.
- <sup>5</sup>Rodden, W. P., "A Method for Deriving Structural Influence Coefficients from Ground Vibration Tests," *AIAA Journal*, Vol. 5, May 1967, pp. 991-1000.
- <sup>6</sup>McGrew, J., "Orthogonalization of Measured Modes and Calculation of Influence Coefficients," *AIAA Journal*, Vol. 7, April 1969, pp. 774-776.
- <sup>7</sup>Berman, A., "Mass Matrix Correlation Using an Incomplete Set of Measured Modes," *AIAA Journal*, Vol. 17, October 1979, pp. 1147-1148.
- <sup>8</sup>Chen, J. C., and Garba, J. A., "Analytical Model Improvement Using Modal Test Results," *AIAA Journal*, Vol. 18, June 1980, pp. 684-690.

AIAA 81-4100

## Reply by Author to W.P. Rodden

Menahem Baruch\*

Technion—Israel Institute of Technology, Haifa, Israel

**R**ODDEN puts the wagon in front of the horses. The choice of credibility factors has nothing to do with the orthogonalization procedure itself. The credibility factors

Received Jan 5, 1981.

\*Professor, Dept. of Aeronautical Engineering. Member AIAA.

must be determined in connection with the method of measurement, and not by comparison among different methods<sup>1,2,3</sup> as Rodden tries to do using his carefully performed calculations. Let us assume, for example, that in some given method of measurement the error in the measured amplitude does not depend on the magnitude of the amplitude itself. Clearly, in this case, the credibility factors must be proportional to the magnitude of the amplitude. Here it seems natural to make the credibility factors proportional to the mean value of the given measured mode,

$$\alpha_i = \beta \sqrt{\bar{T}_i^T M \bar{T}_i} \quad (1)$$

where  $\alpha_i$  is the credibility factor,  $\beta$  is some common multiplier,  $M$  is the mass matrix and  $\bar{T}_i$  is the measured mode shape which must be given in the same units for all measured modes.

In some other methods of measurement the errors in the measured modes can be some function of the modal frequencies and then, the credibility factors will be chosen in connection with this function. This is the reason why the assignment of the credibility matrix was left in Ref. 1 to the discretion and intuition of the practicing engineer. Note that the method of measurement is not mentioned in the comment.

It must be added that the orthogonalized modes are needed to calculate the corrected stiffness matrix.<sup>1,4,5,6</sup> Only then is the structural system identification completed.

### References

- <sup>1</sup>Baruch, M., "Proportional Optimal Orthogonalization of Measured Modes," *AIAA Journal*, Vol. 18, July 1980, pp. 859-861.
- <sup>2</sup>Rodden, W.P., "A Method for Deriving Structural Influence Coefficients From Ground Vibration Tests," *AIAA Journal*, Vol. 5, May 1967, pp. 991-1000.
- <sup>3</sup>McGrew, J., "Orthogonalization of Measured Modes and Calculation of Influence Coefficient," *AIAA Journal*, Vol. 7, April 1969, pp. 774-776.
- <sup>4</sup>Baruch, M. and Bar-Itzhack, I.Y., "Optimal Weighted Orthogonalization of Measured Modes," *AIAA Journal*, Vol. 16, April 1978, pp. 346-351.
- <sup>5</sup>Baruch, M., "Optimization Procedure to Correct Stiffness and Flexibility Matrices Using Vibration Tests," *AIAA Journal*, Vol. 16, Nov. 1978, pp. 8-10.
- <sup>6</sup>Baruch, M., "Selective Optimal Orthogonalization of Measured Modes," *AIAA Journal*, Vol. 17, Jan. 1979, pp. 120-121.