References

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[2]Ibrahim, S.R. and Papa, R.S., "Large Modal Survey Testing Using the Ibrahim Time Domain Identification Technique," *Journal of Spacecraft and Rockets,* Vol. 19, Sept.-Oct. 1982, pp. 459-465.

[3]Pappa, R.S. and Ibrahim, S.R., "A Parametric Study of the Ibrahim Time Domain Modal Identification Algorithm," *Shock and Vibration Bulletin,* Vol. 51, May 1981, pp. 43-72.

[4]Dunn, W.H., "Modal Analysis of Transient Response Data Using a Complex Exponential Algorithm," National Engineering Laboratory, East Kilbride, Scotland, N.E.L. Rept. 641, Aug. 1977.

[5]Wilkinson, J.H. and Reinsch, C., *Handbook for Automatic Computation, Vol. 2: Linear Algebra,* Springer Verlag, Berlin, 1972.

Reply by Author to J.A. Brandon

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EQUATIONS (1) and (2) in Brandon's Comment are not the basis for the Ibrahim Time Domain (ITD) Method. These equations are only used in the special case of computing normal modes from measured complex modes. The ITD identification algorithm, however, uses Eq. (3) as the mathematical model for the identification of modal parameters.

According to the Comment, Brandon's concern is the validity of the theory of oversized identification model reported in his Ref. 2.

Such concern is based on the necessary orthogonality requirement between the noise modes subspace $\{N_k\}$ and structural modes subspace $\{p_k\}$. The fact is that these two subspaces will be orthogonal. The vectors $\{N_k\}$ are neither defined nor unique, but they are merely computational modes. If the matrix A is successfully computed, and since the set of vectors $\{p_k\}$ and $\{N_k\}$ are both the eigenvectors of one matrix, they will come out to be mutually orthogonal.

Engineering applications of mathematics are usually based on assumptions that are later tested for validity. The ones used in the theory of the oversized identification model, after extensive testing, have proved to be sound ones. In Brandon's Ref. 2, a two-degree-of-freedom system, with the severe simulated conditions of extremely low levels of measurements noise and ill conditioning, was successfully identified using a 300-degree-of-freedom identification model.

Perhaps a supplement to Brandon's Eq. (4) stating that "where the subspace $\{N_k\}$ is assumed to be orthogonal to the subspace $\{p_k\}$...," would have obviated this debate.

Using the same reasoning as in Brandon's explanation with matrices D and R, it also could have been as easily assumed that R has a rank of $2n$ rather than $(2n-2m)$. The vectors r_k can be expressed as:

$$r_k = \sum_{i=1}^{2n} W_i f_i(t_k)$$

where $\{W_i\}$ is linearly independent. In such a case $\{W_k\}$ and $\{N_k\}$ will be related by:

$$\sum_{i=1}^{2n} W_i f_i(t_k) = \sum_{i=1}^{2n-2m} N_i e^{r_i t_k}$$

Before introducing the concept of the oversized identification model, time domain identification of modal parameters of structures proved to be unfeasible. This was due to the inability to precisely determine the number of modes contributing to the responses and to easily deal with high levels of noise. The concept under discussion offers a direct approach to solving these two problems. To the best of my knowledge, this concept is being used in most of the newly developed time domain identification algorithms.

In closing, I would like to express my sincere thanks to Dr. Brandon for his interest and for allowing me the opportunity to try to clarify this issue.

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Addendum: "Generalized Dynamic Reduction in Finite Element Dynamic Optimization"

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WE would like to call the reader's attention to the fact that Generalized Dynamic Reduction is a novel concept introduced by Dr. Richard H. MacNeal of the MacNeal-Schwendler Corp., as mentioned in Ref. 3 and in the backup paper. The following references should be added to this Synoptic.

[6]"MSC/NASTRAN Application Manual," The MacNeal-Schwendler Corp., Los Angeles, Calif., April 1981, pp. 2.4 1-2.4.39.

[7]"Handbook for Dynamic Analysis," The MacNeal-Schwendler Corp., Los Angeles, Calif., 1983, pp. 4.1.5-4.1.13.

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Errata: "The Two-Dimensional Laminar Wake with Initial Asymmetry"

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[AIAA **21**, pp. 1347-1348 (1983)]

OMISSION of certain parentheses has distorted two equations in this paper. Equation (6) should read:

$$\bar{u} \equiv 1 - \frac{u}{u_e} = \bar{u}(x,y;M_e,T_w/T_{oe},P)$$

$$= \frac{1}{2}\Big\{\exp[(P+1)^2 x + (P+1)y]$$

$$\times\left[1 - \mathrm{Erf}\left((P+1)\sqrt{x} + \frac{y}{2\sqrt{x}}\right)\right]$$

$$+ \left(\exp\left[\left(\frac{P+1}{P}\right)^2 x - \left(\frac{P+1}{P}\right)y\right]\right)$$

$$\times\left[1 + \mathrm{Erf}\left(\frac{y}{2\sqrt{x}} - \frac{P+1}{P}\sqrt{x}\right)\right]\Big\}$$

and Eq. (8) should read:

$$\bar{u}(y=0) = e^{4x}(1 - \mathrm{Erf}2\sqrt{x})$$

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