Reply by Author to A. H. Flax

J. Brandon*
University of Wales, Institute of Science and Technology, Cardiff, Wales, U.K.

AS remarked by Flax, the expressions derived by the author[1] for second-order sensitivities are limited to stiffness modifications for the conservative case. This is a consequence of the perturbation equation (3)[1]

$$(\lambda \underset{\sim}{A} + \underset{\sim}{B})\underline{x} = \epsilon \underset{\sim}{Q}\underline{x}$$

where $\underset{\sim}{Q}$ is treated throughout as a constant perturbation matrix and cannot subsequently be treated as a function of λ.

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*Lecturer in Manufacturing Systems.

The extension of the analysis provided by Flax shows that for mass modifications an additional term enters the second-order perturbation. This would be of considerable significance if the second-order sensitivities were to be used in the synthesis of modified systems. The original paper[1] concerned itself specifically with the dangers of neglecting second-order sensitivities in system synthesis. In this respect, the work of Flax supports this, particularly his Eq. (8). A fuller treatment of this and similar problems may be found in Lancaster.[2]

Recent work by Tomita and Frohrib[3] may lead to extrapolations similar to those implied by Vanhonacker,[4] where second- and higher-order sensitivities are neglected in predicting effects due to design changes.

References

[1] Brandon, J. A., "Derivation and Significance of Second-Order Modal Design Sensitivities," *AIAA Journal*, Vol. 22, May 1984, pp. 723-724.
[2] Lancaster, P., *Lambda Matrices and Vibrating Systems*, Pergamon, Press, New York, 1966.
[3] Tomita, K. and Frohrib, D. A., "Sensitivity Functions as Predictors of the Influence of Design Parameters on Frequency Response Properties," ASME Paper 83-DET-97, 1983.
[4] Vanhonacker, P., "An Introduction to Sensitivity Analysis," Sixth Modal Analysis Seminar, University of Leuven, Sept. 1981.