Technical Comments

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Reply by the Authors to C. F. Lü and W. Q. Chen

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IN our paper,[1] we presented a general method for free vibration analysis of three-dimensional frames based on Timoshenko beam theory using the exact transfer dynamic stiffness matrix. We appreciate the comments by Lu and Chen[2] regarding the numerical instability of the dynamic analysis in transfer matrix method. They concluded that "We hope, through this Comment, the reader, who is not familiar with the history of structural matrix method widely used in 1950–1960s, will become aware of this numerical instabil-

ity. Several effective, although not universal, methods have been proposed to overcome the difficulty, as summarized by Pestel and Leckie."[2] However, we do not experience any numerical instability. The following is a brief explanation of this fact.

In our method, the eigenvalues are not calculated by evaluation of the determinant as the transfer matrix. In fact, our method is based on the algorithm developed by Wittrick and Williams.[3] In this method, the eigenvalues are computed by a generalized Sturm sequence property of the dynamic matrix. This is achieved by triangularization of the symmetric dynamic stiffness matrix, and the number of eigenvalues can be estimated by sign changes of the diagonal terms. Thus, in our method, we do not need to evaluate any determinant. For details of this method, please refer to Ref. 4. Because matrix triangularization is a stable numerical procedure, we believe that is why we do not encounter any numerical instability in our calculations.

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References

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[2]Lü, C. F., and Chen, W. Q., "Comment on 'Exact Dynamic Analysis of Space Structures Using Timoshenko Beam Theory,'" *AIAA Journal*, Vol. 44, No. 6, 2006, pp. 1372, 1373.

[3]Wittrick, W. H., and Williams, F. W., "A General Algorithm for Computing Natural Frequencies of Elastic Structures," *Quarterly Journal of Mechanics and Applied Mathematics*, Vol. 24, 1971, pp. 263–284.

[4]Yu, J. F., "Vibration and Sensitivity Analysis of Structures with Optimal Design Using Transfer Dynamic Stiffness Matrix Method," Ph.D. Dissertation, Univ. of Texas, Arlington, TX, 2001.

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