

# Readers' Forum

Brief discussion of previous investigations in the aerospace sciences and technical comments on papers published in the AIAA Journal are presented in this special department. Entries must be restricted to a maximum of 1000 words, or the equivalent of one Journal page including formulas and figures. A discussion will be published as quickly as possible after receipt of the manuscript. Neither the AIAA nor its editors are responsible for the opinions expressed by the correspondents. Authors will be invited to reply promptly.

## Comment on "Fuzzy Finite Element Approach for the Analysis of Imprecisely Defined Systems"

I. Elishakoff\*

Florida Atlantic University,  
Boca Raton, Florida 33431-0991

IN the definitive paper by S. S. Rao and J. P. Sawyer,<sup>1</sup> the authors mention in the Introduction that "depending on the nature and extent of uncertainty present in an engineering system three approaches can be used for the analysis as indicated in the uncertainty triangle of Fig. 1." It appears to be instructive to bring to the attention of the readers that the notion of the uncertainty triangle was introduced by the present writer.<sup>2</sup> Reference 2 also includes the figure reproduced in Ref. 1. Analogously, in Ref. 2 the present writer has coined the notion of "anti-optimization" (see also Refs. 3 and 4 in this respect), one of the corners of the uncertainty triangle and used in the figure of Ref. 1.

### References

<sup>1</sup>Rao, S. S., and Sawyer, J. P., "Finite Element Approach for the Analysis of Imprecisely Defined Systems," *AIAA Journal*, Vol. 33, No. 12, 1995, pp. 2364–2370.

<sup>2</sup>Elishakoff, I., "On the Uncertainty Triangle," *Shock and Vibration Digest*, Vol. 22, No. 10, Editorial, 1990, p. 1.

Received July 15, 1996; accepted for publication Oct. 18, 1996; also published in *AIAA Journal on Disc*, Volume 2, Number 2. Copyright © 1996 by the American Institute of Aeronautics and Astronautics, Inc. All rights reserved.

\*Professor, Department of Mechanical Engineering.

<sup>3</sup>Elishakoff, I., "Convex Versus Probabilistic Modeling of Uncertainty in Structural Dynamics," *Structural Dynamics: Recent Advances*, edited by M. Petyt, H. W. Wolfe, and C. Mei, Elsevier, London, 1991, pp. 3–21.

<sup>4</sup>Elishakoff, I., Haftka, R. T., and Fang, J. J., "Structural Design Under Bounded Uncertainty: Optimization with Anti-Optimization," *Computers and Structures*, Vol. 53, No. 6, 1994, pp. 1401–1405.

## Reply to I. Elishakoff

S. S. Rao\* and J. P. Sawyer†

Purdue University, West Lafayette, Indiana 47907-1288

THE authors appreciate the comments of I. Elishakoff on our paper. It is true that the idea of treating uncertainty through probabilistic, fuzzy, and anti-optimization approaches and the concept of the uncertainty triangle were first presented in the editors' rattle space of *Shock and Vibration Digest*, Vol. 22, No. 10, 1990. An extensive discussion of the various uncertainty approaches as well as a reference to the editorial of Elishakoff were included in our original manuscript; however, they were deleted, unfortunately, along with several other parts in subsequent modifications to reduce the manuscript to an acceptable length. Although the notion of anti-optimization was not used in our paper on the fuzzy finite element method, the references indicated by Elishakoff would prove valuable to researchers working in the field of uncertainty analysis.

Received Oct. 11, 1996; accepted for publication Oct. 11, 1996; also published in *AIAA Journal on Disc*, Volume 2, Number 2. Copyright © 1996 by S. S. Rao and J. P. Sawyer. Published by the American Institute of Aeronautics and Astronautics, Inc., with permission.

\*Professor, School of Mechanical Engineering, 1288 Mechanical Engineering Building. Member AIAA.

†Graduate Research Assistant, School of Mechanical Engineering.