# A METHODOLOGY FOR SYSTEMATICALLY STUDYING THE EFFECT OF SYSTEM UNCERTAINTY ON SYSTEM RESPONSE

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A methodology has been recently introduced for establishing an integral expression for the variance of the response displacements of stochastic structural systems (specifically statically indeterminate frame structures) whose material properties are modeled by random fields. The integral form involved the so-called variability response function (VRF) and the spectral density function of the stochastic field modeling the inverse of the modulus of elasticity. A conjecture had to be made which was validated numerically using extensive Monte Carlo simulations. It was demonstrated that the VRF is a function depending on deterministic parameters related to the geometry, boundary conditions, (mean) material properties and loading of the structural system, as well as on the standard deviation of the stochastic field modeling the inverse of the elastic modulus. A Fast Monte Carlo Simulation approach was provided to numerically evaluate the VRF. The integral form can be used to compute the variance of the system response, as well as its upper bound with minimal computational effort (depending on the amount of probabilistic information available). In addition, it provides an excellent tool for performing sensitivity analyses examining the effect of system uncertainty on the stochastic system response with minimal computational effort.

In this work, a series of new developments related to the aforementioned methodology are presented. First, analogous integral expressions are introduced for the mean value and the mean square value of the response displacement. Then, more complex structures are analyzed including plates and shells. Furthermore, a series of important insights are provided concerning the numerical validation of the conjectures, including the accuracy of the Monte Carlo simulations used to achieve this objective. Finally, the problem of extending the methodology to establish analogous integral expressions for the mean, mean square and variance of the response stress is discussed. Fundamental differences in the behavior of the response between the two problems (displacements versus stresses) are identified and examined.

## References

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