Summary

Numerical Analysis of Static and Dynamic Sensitivity of Complex Structural Systems with Random Parameters

In the paper the static and dynamic sensitivity problems of structural multi-degree-of-freedom systems are considered in terms of uncertainties in design parameters. Starting from the stochastic version of Lagrange equations, based on the mean-point second-order perturbation method, the hierarchical sets of equations of motion and equilibrium are formulated. The first two probabilistic moments of time-dependent and time-independent structural response as well as the first two probabilistic moments of static and dynamic sensitivity are derived with the mean values and cross-covariances of design parameters on input. It allows one to get not only the deterministic results of static and dynamic structural response and their sensitivities, but also the solution accuracy in the form of the mean values and their cross-covariances.

The formulations are illustrated by a number of numerical examples, cable-stayed bridges and bar domes, for instance. For the suspended bridge, a model with 3563 degrees of freedom, consisting of 154 truss elements, 510 beam elements and 635 shell elements, is adopted. For the 80-bar dome four various models are discussed to verify the influence of finite element setting on numerical results. A few model examples are analyzed and obtained results are compared with exact (analytical) solutions presented in the literature.

The beat effects in the structures with repeated geometry is observed and eliminated by using added masses and dampers. The way of processing and entering the cross-covariances matrix for design random variables is presented in a Fortran procedure.

The problem of systems with repeatable eigenvalues and the influence of parameter selection on the result accuracy are included. In the appendices some computer codes to generating input data of the complex structural model and to forming the cross-covariances matrix of random parameters are shown.

The paper is finished with concluding remarks on the effectiveness of the above-mentioned formulations and with some new aspects related to the future work.