Sample-based Reliability Estimation Method in Computational Mechanics employing Extreme Value Distribution

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The performance of a mechanical system can be represented by properties of the system parameters such as stiffness, damping, mass and etc. Such system parameters always contain uncertainties caused by material irregularities and manufacturing tolerances. If the uncertainties of the system parameters increase, the uncertainty of a system performance increases. So, the reliability of the system performance decreases. Therefore, to increase the reliability of the performance, the reliability of the performance has to be analyzed and reliability design of the performance should be conducted. In order to analyze the reliability of the performance using most of existing uncertainty analysis methods, probability density functions of all uncertain system parameters need be identified. Practically, however, it is almost impossible to identify the density functions. In this case, the reliability of the performance should be estimated based on uncertain system parameter samples. In this paper, a sample-based reliability estimation method in computational mechanics employing an extreme value distribution was proposed. The accuracy and effectiveness of the proposed estimation method was validated through numerical examples. Using the proposed reliability estimation method, reliability design was also carried out for the examples.

Keywords: Uncertainty, Sample, Reliability, Confidence interval, Extreme value distribution

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