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NASA TECH BRIEF

On the Bound of First Excursion Probability

Bounding techniques of the first excursion probability in the area of random vibrations have received considerable attention because of their direct applications in assessing the reliability performance of mechanical structures subjected to random external disturbances. Previous studies have not presented solutions to the governing equations associated with the initial and boundary conditions pertinent to the present first passage time problem. Another limitation of previous work is due to the restriction that the input be "white" even though the system is assumed to possess narrowband characteristics. As a result of these limitations this study was undertaken to provide alternative methods by which additional information and practical results were obtained not only for the (stationary) white noise input, but also for more general cases involving nonstationary and nonwhite inputs. A method has been developed to improve the lower bound of the first excursion probability that can apply to the problem with either constant or time-dependent barriers. The method requires the knowledge of the joint density function of the random process at two arbitrary instants. Other than this, the method can apply to stationary or nonstationary, Gaussian or non-Gaussian processes.

Numerical examples have indicated that the improvement is significant for the work involved and that the difference between the upper and lower bounds has been narrowed considerably, particularly for the example involving the nonstationary process.

Note:

Documentation is available from:
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No patent action is contemplated by NASA

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