11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

High reliability estimation using CVaR+

Palaniappan Ramu[1]

[1] Indian Institute of Technology, India

Abstract

Value at Risk (VaR) are inverse measures which are essentially quantiles used for reliability estimation and are volatile in their tail regions. This volatility leads to error in predictions for unknown reliability levels. Conditional VaR (CVaR) is a weighted sum of CVaR+ and VaR where CVaR+ is the mean responses strictly exceeding VaR. CVaR+ is also referred to as buffer probability in structural reliability theory [1]. It is observed that CVaR+ is less volatile in tail portion and is smoother than the VaR and CVaR though conservative from both, in a failure prediction. This work utilizes the fact that CVaR+ is well behaved and smooth, to fit the relationship with its Cumulative Density Function (CDF).

The tail part of relationship between CVaR+ and the empirical CDF is approximated using a Generalized Pareto Distribution to estimate failure probability. A family of polynomials can also be used in a transformed axis [2]. The extrapolated results for a set of true distributions covering all types of tails are better compared to predicting VaR using the same procedures. The variation of CVaR+ is much lesser than that of VaR. However, the CVaR+ is a conservative estimate compared to VaR. Here, we model the relationship between the VaR and CVaR+ for the native scarce samples and try to extrapolate their relationship as well. In the true distributions tested, the difference is linear allowing a simple addition to the predicted CVaR+ to obtain the VaR. The final paper will demonstrate the approach on additional practical engineering examples.