Distribution-Free Uncertainty Quantification

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The approach to be discussed is an extension of classical interval analysis, *i.e.* "Given bounds on the input parameters to a simulation code, what is the possible extent of the range of output function?" Since the computational models of interest are blackboxes, only those interval techniques that are not intrusive to the analysis code. The interval analysis problem is especially difficult in the case of blackboxes as the minimum and maximum of the output(s) often occur at interior points of the ranges of the input variables, e.g. resonance phenomena. The propagation of the uncertainty in the case of interval uncertain input variables is accomplished by the formulation and solution of two global optimization problems with bounded constraints. It can be shown that this formulation is also applicable if there is enough information to specify some input parameters as random variables and others as intervals or a combination of these. Along with bounds on the outputs, a probability estimate that the output lies in this pertinent region, *e.g.* an interval or hyper-box, is calculated using Frechet bounds. It can be shown that these probability estimates are lower bounds, thus always conservative in nature. Several examples will be given.