STOCHASTIC SIMULATION METHODS

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This paper provides a critical overview of the current practice in the computer simulation. It is argued that contemporary simulation techniques overlook the stochastic character of physics, leading to dangerous misconceptions. One such misconception is that it is possible to optimize a product design for a particular characteristic. Phenomena, such as automotive crash, that are chaotic and/or random in nature are inherently deprived of any form of predictability. It is this lack of predictability that directly precludes optimization. Phenomena of this type, that are non-repeatable, require a totally different approach, not based on optimization. This new approach, stochastic simulation, is described in the paper.

New engineering analysis methods that take advantage of newly available compute capabilities are now being used. These methods are stochastic in that they address a broad spectrum of likely conditions, taking the uncertainty and variability of geometry, material properties, and forces into account in simulations. The application of stochastics uses advanced Monte Carlo techniques. The results of a stochastic simulation are displayed in a cloud of points that represents the reality of the physics being modeled, with each point representing a possible situation. The cloud resulting from stochastic simulation can more readily be validated with physical testing than models from deterministic analyses. Design improvements can be realized by using the Stochastic Design Improvement (SDI) process to move the cloud towards design targets.

Some companies in the have started to apply stochastics to design with significant success. EADS-CASA has reduced weight of a satellite launch dispenser from 500 to 337 lbs by changing the composite layup following stochastic simulation. Application of this process in the auto industry has resulted in improved crash worthiness with weight reduction following analyses of multiple crash scenarios, car noise, vibration and ride harshness. BMW reduced weight in a car model by 33 pounds, Nissan - 35 pounds, other cars at other companies had weight reductions of 55, 40, and 13 pounds. These companies have invested in supercomputers dedicated to running stochastic simulation to improve product reliability and reduce risk.