IASSAR SC1-WG4 on Monte Carlo Simulation Algorithms

1 The Concept

Monte Carlo Simulation (MCS) is considered at the present as the only tool available, which can be applied to every field in stochastic computational mechanics. The recent development towards low cost and ever increasing computational power favors the application of MCS in structural mechanics. The generality and simplicity of MCS, however, is associated with considerable computational effort. Depending on the model and the problem set, the required computational effort might not be economic or even not feasible. In other words, the *computational efficiency* is a key issue for the attractiveness of MCS in structural mechanics. This issue is almost independent of the development of computational resources since the benefit of employing MCS will certainly be compared with the effort of structural analysis procedures used for deterministic analysis.

It is therefore the intention to compile an IASSAR-report, in which computational efficiency plays a major role. More specific, contributions concerned with methods and associated algorithms going beyond direct MCS are encouraged. Typical algorithms developed to increase the computational efficiency are

- Importance Sampling including Directional Sampling, Adaptive Sampling, Adaptive Directional Sampling, etc..

- Latin Hypercube and Stratified Sampling

- Controlled MCS employing Russian Roulette and Splitting or Double and Clump.

- Karhunen-Loéve Expansion or Principal component analysis, covariance decomposition

- Neumann expansion, Taylor expansion, Chaos expansion

- Phase Space reduction in MCS

The above list exemplifies the topic and is by no means meant to be complete.

Another aspect of efficiency is the possibility of parallel computing. Direct MCS is most suited for distributed computing end even massively parallel processing. By using techniques, which go beyond direct MCS, some of the advantages might be lost. It is therefore reasonable to take also this aspect into account when the gain in computational efficiency is discussed. Reference to SC1 Group 2 should be made in this context.

The IASSAR report should provide an overview over recent developments in the field of MCS (geared towards an increase in computational efficiency). The range of applicability should be identified.

Revised Outline of Group Report

Chapter No.	Topic	Author
1	General Remarks	Pradlwarter
2	Direct Monte Carlo Simulation	Pradlwarter / Schuëller
3	Simulation of Input	
	3.1 General Remarks	Grigoriu /Poirion
	3.2 Independent Random Variables	Poirion
	3.3 Correlated Gaussian Variables	Poirion
→	3.4 Correlated Non-Gaussian Variables	Grigoriu /Poirion (3.4.1)
	3.5 Random Fields	Grigoriu
4	Stochastic Structural System	
	4.1 Stochasic Systems Properties	
	4.1.1 Stochastic Static Loading	Grigoriu
	4.1.2 Stochastic Dynamic Loading	Grigoriu / Takada
→	4.1.3 Sochastic Linear Systems (Random Eigenvalues)	Grigoriu / Pradlwarter / Schuëller (4.1.1)
	4.1.4 Stochastic Nonlinear Systems	Schuëller / Pradlwarter
	4.2 Deterministic System	
	4.2.1 Properties of Stoch. Static Loading	
	4.2.2 Stochastic Dynamic Loading	Griogriu / Takada
→	4.2.3 Linear Systems	Grigoriu / Poirion
	4.2.4 Nonlinear Systems	Grigoriu / Pradlwarter
5	Stochastic Response	
	5.1First two Moments (mean vector, covariance matrix)	Grigoriu / Beck / Takada
	5.2 Higher Moment and Distributions	Grigoriu / Cai
	5.3 Reliability in Static Analysis	Pradlwarter / Schuëller / Mahadevan
	5.4 Reliability in Dynamical Analysis (Exceed. Problems)	Takada / Pradlwarter / Schuëller / Grigoriu

REFERENCES