Uncertainty in Geo-science: A Workshop on Hazard Analysis

Prof. Abani Patra

University at Buffalo

15-17 March , 2016

OUTLINE

Problem Statement

Study of physical phenomena involved with uncertainty in input parameters:

- **Intrusive**: change the original governing equation.
  - Polynomial Chaos Stochastic Galerkin.
  - Perturbation methods
  - ...
- **Non-intrusive**: *do not* change the original governing equation.
  - Monte Carlo & LHS
  - Important sampling Methods
  - Non-intrusive spectral projection (NISP)
  - ...

Latin Hypercube Sampling (LHS)

Generating a sample set of uncertain values from equally probable intervals of the probability density function.
Algorithm:

1. Select the pdf
2. Select the number of samples
3. Divide the pdf function into equal probability intervals.
4. Generate random samples on each interval.

Advantage:

- Much less number of samples require for convergence compared to MC
- No need to change the original solver (like any other non-intrusive method)

Polynomial Chaos Quadrature (PCQ)

The basic idea comes from projection theory that each function can be written as an expansion of a series of orthogonal function:

$$h(\eta) = \sum_i a_i \Psi_i(\eta)$$

So any uncertain parameter in the model can be expressed as above. Usually in UQ we are interested in computing the moments (an integral), by using the concept of the quadrature points for computing those integrals and truncating the series after few terms we can approximate the desired functions effectively.

Thank You ...