Comparison Of Advanced Sampling Methods For Bayesian System Identification

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Virtual behavior of structures is examined by using mechanical models which consists of a set of equations and boundary conditions that describe the physical input parameters such as the geometric, material, damping properties and loading conditions. Updating these parameters of expressing the structure is necessary to obtain numerical responses that will accurately represent the structure under investigation. The mechanical model itself and some of the model parameters are uncertain and they are modelled as random variables. Moreover, new observations or data on a mechanical model, if available, can be used to update the model. For this purpose, Bayesian updating framework in which prior probabilistic models are updated with data and observations is one of the most well-established probabilistic approaches and can be used for model updating. Defined model parameters are updated by probability density functions (PDFs) and the posterior probability density functions are calculated using Bayesian inference. Unfortunately, the posterior distribution contains high dimensionality and complex geometry which makes it difficult to evaluate. This problem can be overcome by using the advanced sampling methods. Therefore, Bayesian updating is commonly conducted through sampling methods. Advanced Monte Carlo sampling methods are popular and preferred widely since they allow the generation of samples from the posterior PDFs without having to solve the potentially high dimensional integral in the Bayesian formula. In addition, these methods can be applied and adopted easily into the Bayesian updating framework of the mechanical models. In line with this information, the model updating is open to development and an important issue for structures to be determined since its integration is useful for detection of structural damage and risk assessment. Bayesian analysis is considered to be one of the leading methods in making such evaluations. However, advanced sampling methods are required to handle complex integrals in the Bayesian inference. Therefore, the use of popular advanced sampling techniques in the context of Bayesian updating is investigated in this paper. Advantages and limitations of the examined sampling techniques are presented considering case studies. Furthermore, it tries to give inferences about how each sampling technique will be selected depending on the problem to be addressed and the validity of its assumption according to the available computational power.