In the last years there has been a growing use of Computational Simulation in the design and analysis of complex engineering systems. This has underscored the need of developing methodologies capable of assessing the unavoidable uncertainty contained in the numerical results. One major issue to be deeper understood and controlled is how uncertainties in the input data impacts the reliability of the results obtained through computer simulations. Specifically in the present work, the focus relies on hydro-ship dynamics in the context of floating offshore structures. Particular emphasis is placed on investigating uncertainty propagation in the nonlinear response of flow-structures interactions [1-2], investigating the response of the system to random load, performing a stability analysis of the system. It is important to remind that waves and currents, major agents in the dynamics of the floating structures, are usually modeled as random processes. Therefore, stochastic modeling seems to offer an appropriate framework to handle external forces and uncertainties in the data, like, for instance, damping and boundary conditions. We propose in this work, apply a sparse grid stochastic collocation method [3-5] in a prototype problem of a single oscillator excited by means of an interaction stochastic force corresponding to the Morison formula [1]. The velocity and acceleration of the flow are determined using the Pierson-Moskovitz power spectrum that lead to a highly non-linear equation of motion. Even in the presence of nonlinearity, the collocation approach, approximates the solution in the stochastic space using Lagrange polynomial interpolation, requiring only repetitive calls to an existing deterministic solver, just as in sampling-based methods, such as Monte Carlo. Moreover, uncertainty in the system parameters can be also taken into account. The convergence of the method is analyzed along with the influence of the time step algorithm through a number of numerical experiments. Comparisons with Monte Carlo method are also presented to demonstrate the accuracy and efficiency of the method.

References


