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NUMERICAL MODELLING OF FLOW-INDUCED VIBRATIONS ON STRUCTURES WITH UNCERTAIN INPUT PARAMETERS

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Abstract. The flow-Induced vibrations plays an important role in many fields and is crucial in the design of offshore engineering systems. Vortex shedding behind bluff bodies can cause fatigue in the materials, degrading the performance or even causing structural failure. An accurate prediction of this structural instability is extremely important and has received special attention lately due to its relevance for design of mooring and risers system as well to monocolumn platforms for hydrocarbon exploration in deep waters.The use of mathematical models for reliable computational predictions are important to solve and quantify the effects of physical variations present in engineering problems. The methods available typically assume that the structural properties are known exactly, when in fact it should be modeled in a more realistic way by using random fields resulting in a stochastic differential equations problem. In this sense, a modern approach involves the use of detailed mathematical models that take into account the inherent uncertainties of the parameters and is essential to understanding and using the model predictions within an engineering design process. This work presents a stochastic analysis of this phenomena, taking into account uncertain input parameters in a phenomenological model and in a Navier-Stokes model using a CFD solver. This analyse can help to understand the behaviour of the structure to critical situations and the effects of varying parameters in the response variables. The statistics moments are approximated by the non-intrusive sparse grid stochastic collocation method. This method has emerged in recent years as an attractive technique, due to that allows obtaining approximations of the interpolating function in the stochastic space. The method approximates the solution in the stochastic space using Lagrange polynomial interpolation, providing a simple way to approach the statistical moments of the system outputs. To improve the method when there are steep gradients or finite discontinuities in the stochastic space an adaptive technique was adopted to perform the analysis. Numerical simulations are performed to demonstrate the appropriateness of method applied for characterization of the statistical moments of the critical points as well as for the determination of the probability of occurrence of undesired phenomenon.