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Uncertainty Quantification of a Cantilevered Pipeline Conveying Fluid with Motion Limiting Constraints

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Researchers have studied cantilevered pipelines conveying fluid for many decades for their practical applications and interesting dynamic behaviors. These applications can include oil pipelines and risers, mechanical pumps, and micro/nano-pipelines which can be used in drug delivery. Because the stability of these systems is so important to companies and industries, many researchers have investigated methods to improve the overall system stability. Some of the implemented methods include adding a mass to the tip of the pipe and adding motion limiting constraints which introduces an impacting force that can produce interesting nonlinear chaotic behavior. The implementation of ideas and strategies that improve system stability leads to increasingly more complex systems with a greater number of input parameters. The cantilevered pipe conveying fluid itself already has many parameters to consider including the flow speed of the liquid in the pipe, the smoothness of the internal structure, size of the pipe, and the position of motion limiting constraints to name a few. Additionally, each input parameter possesses its own uncertainty. The propagation of uncertainty in these parameters can significantly alter the dynamic response and stability of the proposed system. It is important for engineers to design the system with a firm understanding of how the system is going to behave and respond in the presence of these uncertainties. Therefore, it is necessary to employ uncertainty quantification methods. In this study, a sensitivity analysis will be performed on a cantilevered pipeline conveying fluid with motion limiting constraints to determine which parameters in the system are most dominant. By finding these dominant parameters, more uncertainty quantification methods can be employed to better understand the response of the system.

Keywords: Uncertainty Quantification, Nonlinear Behavior, Fluid-Structure Interaction

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