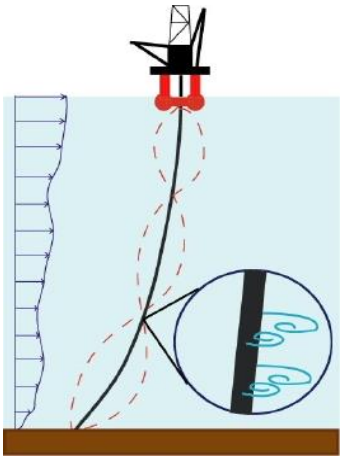
Offshore & Dredging Engineering

Technische Universiteit Delft

Motion reconstruction of vortex-induced vibration of long flexible riser from experimental and field VIV test data.

Vortex-induced vibration (VIV) of long flexible cylindrical structures enduring ocean currents is ubiquitous in the offshore industry. Though significant effort has gone into understanding this complicated fluid-structure interaction problem, major challenges remain in modelling and predicting the response of such structures. The work presented in this thesis applies the modal approach to do motion reconstruction of the riser VIV from experimental data at first and then performs some analyses to the riser VIV response based on the reconstructed result.



In the first part of the thesis, the modal approach is classified into the frequency domain method and the time domain method according to the types of the measurement data. Two systematic frameworks to do motion reconstruction are built for these two methods. Besides, two factors probably leading to the reconstruction error are proposed. One is using the strain measurement to identify the low modes VIV motion and the other one is unreasonable choice of participating modes.

In the second part of the thesis, the riser VIV motion in ExxonMobil VIV test is reconstructed using the frequency domain method and that in the second Gulf Stream VIV test is reconstructed using the time domain method. In the reconstruction process, several problems are needed to be solved, such as the choice of time window, filtering data and the choice of participating modes. And the accuracy of the reconstructed result is verified using the extraction method. Finally, two examples are given to demonstrate the reconstruction errors induced by the above two facors.

In the final part of the thesis, some key parameters are extracted out to show the effects of external conditions, e.g. current profile, current speed and strake coverage, on the VIV displacement magnitude and response frequency of the riser. Besides, three methods are provided to identify the travelling wave in the riser VIV response.

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