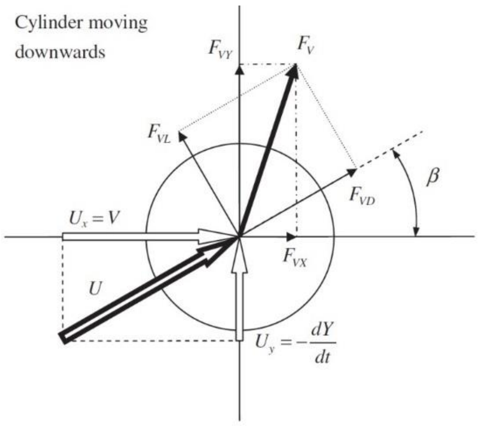
TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

Modelling of vortex-induced vibrations through the wake-oscillator model

Energy produced by Offshore Wind Farms is transported to shore by cables that go underneath the seabed. Even though these cables are supposed to be buried, sand migration and scour can remove their protective layer, leaving the cables exposed to currents. Currents induce forces on the cable, causing it to respond dynamically.
Depending on the amplitude and frequency of the vibrations, the cable can have its operational lifetime reduced due to fatigue. It is often the case that researches resort to small-scale models to assess the behavior of cylindrical structures subjected to flows. The most common experiment is to submerge a cylinder in water and then measure the forces and displacements for different flow speeds. Forces and displacements can thereafter be upscaled to realistic models.
It is important to understand how the boundary affects the fluid-structure interaction phenomenon so that these features can be incorporated in empirical model. In order to access this interaction phenomenon, a set of experiments has been designed considering the presence of a boundary near the cylinder (sea bottom)



A wake oscillator model with nonlinear coupling is proposed to model the vortex-induced vibration of an elastically supported rigid cylinder constrained to vibrate in the cross-flow direction far away from the bottom.
The prediction results are applied to check whether the precision of load cell is enough for the designed experiments. The wake oscillator model is extended to simulate the 2DOF free vibration motion.
The robustness of 1D and 2D wake oscillator is checked by introducing a fluctuating current velocity into the model. The X-direction amplitude respond is compared with the results by applying Morison Equation. 1D wake oscillator model is improved by introducing oscillation drag force coefficients and adding a linear relationship between original angle (relative velocity with respect to current velocity) and new angle.
For further study, it is suggested to add a new nonlinear relationship between these two angles.

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