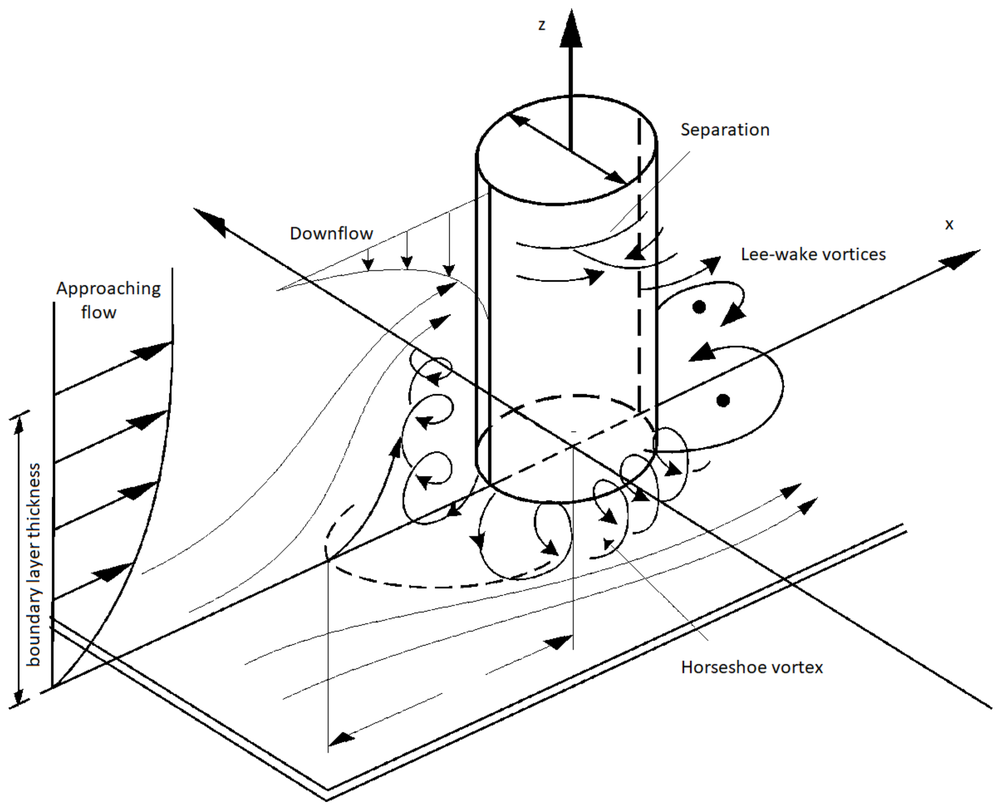
Institute of Fluid Mechanics
and Environmental Physics
in Civil Engineering

Master's Thesis - Fluid-structure and seabed interaction using open-source CFD software (REEF3D)

Examiner: Prof. Dr. sc. nat. ETH Insa Neuweiler
Supervisor: MSc. Ramish Satari

Background

The reliable prediction of scour development is an essential element of foundation structure design and will play an important role for the expansion of offshore wind energy. In general, scour refers to localized removal of soil material around structures installed in fluvial and marine environments. Scour can lead to significant stability problems and eventually structural failure. Although extensive research has been carried out on this topic over the past decades, the occurrence, drivers and effects of scour have been investigated mostly for slender structures such as small-diameter monopiles. On the other hand, scour around larger and more complex foundation structures such as tripods, jackets or large-diameter monopiles was studied less thoroughly so far, although the necessary expansion of offshore wind into deeper waters relies on these very structures. Further information can be found at: `https://www.sfb1463.uni-hannover.de/`.
The numerical validation of REEF3D solvers and as such comparison of their results with the literature plays an important role in order to guarantee the plausibility and accuracy of the numerical results. Within this framework the objective of the **Master thesis** is to investigate numerically the fluid behavior around an obstacle such as vertical cylinder [1, 2].



Research Questions

- What are the major issues when simulating flow around an obstacle using REEF3D?
- What are the effects of boundary condition and initial conditions on the hydrodynamic model?
- What are the major differences between the steady and unsteady solvers?
- Which solver gives the best results?

Tasks

- Investigation on the state-of-the-art (Literature review)
- A Hands-on Introduction to Engineering Simulations using open source CFD software (REEF3D)
- Steady-state analysis
- Unsteady or transient analysis
- Investigation of different solvers
- Representative numerical examples: flow and scour around a vertical cylinder
- Academic Writing (report presentation)

Your Profile

- Background knowledge - Numerical methods in fluid mechanics.
- Basic programming knowledge.
- Motivation and ability to work independently

Contact Information

- satari@hydromech.uni-hannover.de
- Institute of Fluid Mechanics and Environmental Physics in Civil Engineering

CRC1463 Project

Modern offshore wind turbines are expected to make a significant contribution to the success of the energy transition. Future turbines will be significantly larger than today's: over 300 meters in total height and with rotors more than 280 meters in diameter. This means that they will be subject to hardly any known effects or conditions that can develop at heights of over a hundred meters. Due to their dimensions and the more filigree design required for them, environmental influences as well as interactions between individual components become more relevant. Today's established methods for the design and operation of wind turbines are no longer applicable for structures of this size. Therefore, new concepts are being developed in the Collaborative Research Center (CRC 1463) "Integrated Design and Operation Methodology for Offshore Megastructures" at Leibniz Universität Hannover (LUH).

References

[1] C. Baykal, B. Sumer, D. Fuhrman, N. Jacobsen, and J. Fredsoe. Numerical investigation of flow and scour around a vertical circular cylinder. *Philosophical transactions. Series A, Mathematical, physical, and engineering sciences*, 373, 01 2015. doi: 10.1098/rsta.2014.0104.

[2] A. ROULUND, B. M. SUMER, J. FREDSØE, and J. MICHELSEN. Numerical and experimental investigation of flow and scour around a circular pile. *Journal of Fluid Mechanics*, 534:351–401, 2005. doi: 10.1017/S0022112005004507.

[3] Scribbr. The dos and don'ts of academic writing, Jan 2021. URL `https://www.scribbr.com/category/academic-writing/`.