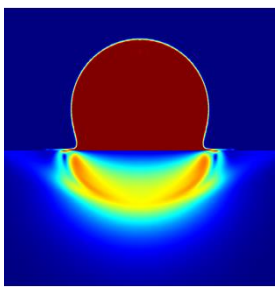
Master Assignment:

“Development of a Two-Phase Flow Fluid-Structure Interaction (FSI) Open-FOAM Based Computational Fluid Dynamics (CFD) Model”

Summary:

Wind turbines are increasing in diameter (>220 m) leading to higher tip speeds (>100 ms^{-1}). Interactions of the high tip speed blades with rain droplets causes erosion damage over time. In order to develop coating materials, the impact pressures that rain droplets cause need to be investigated. For this purpose, multiple numerical models have been developed based on smoothed particle hydrodynamics (SPH) as well as arbitrary Lagrangian Eulerian methods (ALE). Most of these methods neglect the presence of an air layer in between the blade and the droplet. Recent work has shown that this air layer can significantly reduce the impact pressures. The effects of the two-phase flow definition and compressibility in the air layer have not been studied so far and will therefore be the main goals of this assignment.



Objectives:

Develop a compressible two-phase flow fluid-structure interaction (FSI) model to assess the impact pressures resulting from rain droplet impact on wind turbine blade coating materials.

1. Literature study on numerical modeling techniques for two-phase flow FSI methods.
2. Establish an OpenFOAM-based CFD workflow to determine liquid droplet impact pressures at coated substrates.
3. Assess the liquid droplet impact pressure on a rigid target with a compressible background flow with a turbulent zero pressure gradient boundary layer.
4. Perform a parameter analysis for:
   impact velocity, droplet diameter, target elasticity/material parameters etc.
5. Write a report on the applicability of the developed model and the interrelations of impact pressures and the studied parameters.

UNIVERSITY OF TWENTE.

Contact:

Nick Hoksbergen (t.h.hoksbergen@utwente.nl)

Philip Ströer (p.stroer@utwente.nl)