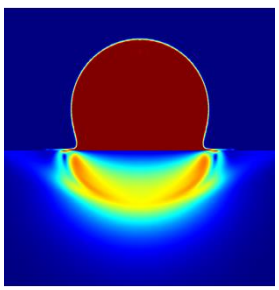
Master Assignment:

"Two-Phase Flow Fluid-Structure Interaction Model for Investigation of Rain Droplet Impact Pressure on Wind Turbine Blades"

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. Develop a sophisticated two phase flow model including compressibility in the fluid domain.
3. Assess the liquid droplet impact pressure on a rigid target.
   a. Perform a parameter analysis for: impact velocity, droplet diameter, etc.
4. Assess the liquid droplet impact pressure on an elastic target.
   a. Perform a parameter analysis for: impact velocity, droplet diameter, coating (viscoelastic) material parameters etc.
5. Write a report on the applicability of the developed model and the interrelations of impact pressures and the studied parameters.

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