Pressure calculation at air/water interface in a Volume Of Fluid (VOF) interface tracking method

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Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Danish Hydrocarbon Research and Technology Centre
Technology Conference 2019

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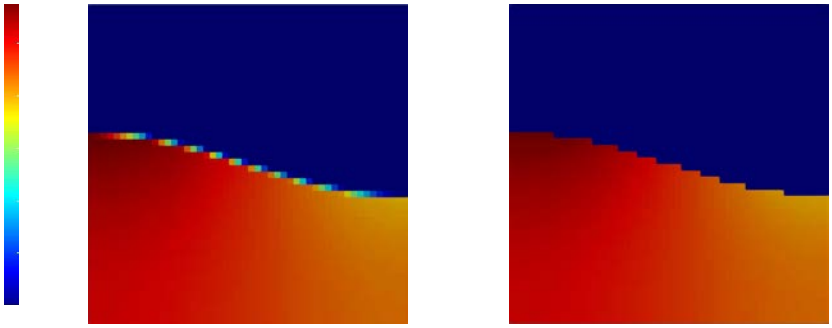
Research program:

Structural Integrity and Pipeline Technology, CTR. 3, Project DEWIOS.

Abstract:

The wave climate during a winter storm in the North Sea can be harsh to structures. Since the age of the structures gets closer to the design lifetime, it becomes important to gain detailed knowledge on extreme wave interaction with the structures. By increasing the certainty of the forces exerted on the structure, it should be possible to extend the lifetime and increase the safety for people working on the offshore structures.



The currently freely available Volume Of Fluid model in the open source software OpenFOAM does not capture the behavior of the pressure correctly close to the free surface. The density jumps at the surface, which can be illustrated by examining the dynamic pressure.

The figure presents a case with a body of water initialized with a sinusoidal height variation. The red and orange region is water, and the blue region is air. The actual pressure values is not important here, only the scale. The figure shows that the current model is not sufficient and the existing method with one-sided interpolation can capture the jump. A correct treatment of the pressure near the interface between water and air is a fundamental and important step towards an improved estimation of forces from extreme waves. Once this is properly tested we can investigate forces and include air and water mixture generated by breaking waves.

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