Numerical simulation of a solitary breaking wave using OpenFOAM

M. Batlle Martin[*], N. Hecht[*], G. Pinon[*,+], J. Reveillon[†] and O. Kimmoun[‡]

[*] Laboratoire Ondes et Milieux Complexes (LOMC)
UMR 6294, CNRS - Normandie Univ. UNIHAVRE
76600 Le Havre, France
[+]e-mail: gregory.pinon@univ-lehavre.fr

[†] COmplexe de Recherche Interprofessionnel en Arothermochimie (CORIA)
UMR 6614, CNRS - Université de Rouen et Institut des Sciences Appliquées
76801 Saint-Etienne du Rouvray, France

[‡] Institut de Recherche sur les Phénomènes Hors Équilibre (IRPHE)
UMR CNRS 6594 - Aix-Marseille Université
13384 Marseille, France

ABSTRACT

Following the work of X. Lu [Lu, 2016], the objective of this paper deals with solitary wave impacts on coastal structures. This study is carried out numerically via the OpenFOAM software, using a Volume of Fluid method to solve two incompressible and immiscible phases (interFoam solver).

At first, the feasibility of such a work with the OpenFOAM software was assessed. To do so, the transport and rebound of a non-breaking solitary wave were evaluated. A comparison of the wave amplitude conservation over time, according to the Boussinesq theory, was also performed and validated. Finally, the maximum water heights on the wall obtained by interFoam were successfully compared with analytical and other numerical solutions.

Secondly, the impact of solitary breaking waves is studied under different configurations, both in 2D and 3D. The solitary wave impact configuration was chosen here because it represents a single event, easier to characterise than if a wave train was used. The aim is here to evaluate the OpenFoam ability to accurately reproduce impact pressures, before applying this software to other configurations, for instance in the field of marine energy. Due to our aim to find the most intense impact cases, the air pocket and flip-through impacts, were first studied. The paper will present an analysis of the free surface evolution, the wave shapes during the impacts and, to end with, the impact pressures series comparing with the experimental results of Kimmoun et al. [Kimmoun et al., 2009].

The already obtained results are accurate in terms of solitary wave propagation and run-up if compared with the theory. For the impact cases, the solitary wave breaking profile impinging the wall and the pressure series are in good accordance with the experiments.

REFERENCES

[1] O. Kimmoun, Y. Scolan, S. Malenica, et al. Fluid structure interactions occuring at a flexible vertical wall impacted by a breaking wave. In *The Nineteenth International Offshore and Polar Engineering Conference*. International Society of Offshore and Polar Engineers, 2009.

[2] X. Lu. Simulation numériques de l'action de la houle sur des ouvrages marins dans des conditions hydrodynamiques sévères. *PhD Thesis*, Normandie Université, 2016.