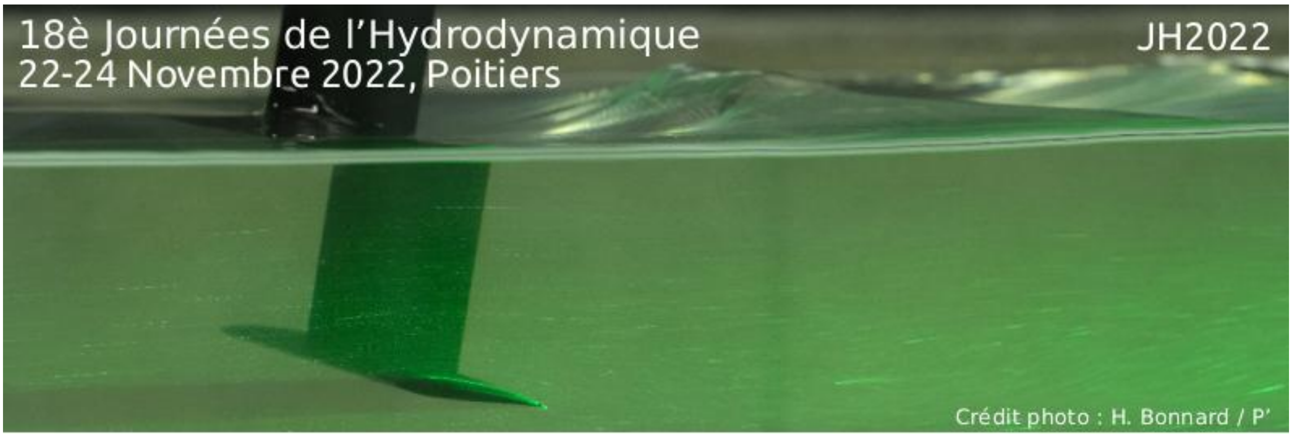

CONDITION DE SAUT EFFECTIVE POUR DES ONDES NON LINEAIRES EN PRESENCE D'UNE TRANSITION DE PROFONDEUR ABRUPTE

EFFECTIVE JUMP CONDITION FOR NONLINEAR WAVES IN THE PRESENCE OF ABRUPT DEPTH TRANSITIONS.

EDUARDO MONSALVE[(1)], AGNES MAUREL[(2)], KIM PHAM[(1)]

eduardo.monsalve@ensta-paris.fr ; agnes.maurel@espci.fr ; kim.pham@ensta-paris.fr

[(1)] IMSIA, CNRS, EDF, CEA, ENSTA Paris, Institut Polytechnique de Paris, 828 Bd des Maréchaux, 91732 Palaiseau, France

[(2)] Institut Langevin, ESPCI Paris, Université PSL, CNRS, 1 rue Jussieu, 75005 Paris, France

Abstract

The propagation of nonlinear waves over variable bathymetry is still rising new questions. In particular, sudden depth transitions attract the interest of numerous scientists due to the inherent difficulties to find theoretical methods that are at the same time, easy to apply and accurate in modeling the reality. So far, sudden depth transitions are often treated either at the linear order or at the nonlinear order using smooth transitions that can be pushed to the limit that allows the model to converge. Moreover, the case of a depth change with a rectangular shape requires special treatment due to the difficulties of theoretical models and numerical calculations to find convergent, continuous and smooth solutions in the neighborhood of the depth discontinuity [1]. In this work, we revisit the canonical problem of a rectangular submerged step in the presence of nonlinear water waves, giving a new approach. asymptotic analysis on the non-linear Euler equations provides the behavior of nonlinear dispersive waves; we recover the family of Boussinesq-type equations in the regions of constant (and different) depths and we find effective jump conditions across the two regions. Similar, through non-identical asymptotic approach has been proposed in [2]. Numerical results, which are still in progress, show interesting results that can be easily compared to experimental data. As we can see in Figure 1, the experimental campaign was carried out at small scale in a harmonic regime using the Fourier Transform Profilometry technique (FTP), based on the measurement of the phase shift of a carrier projected

pattern due to the surface deformation [3], which allows a complete space-time resolved measurement of the wave field. Eventually, the objective of our work is to propose a complete theoretical development, which is a significant contribution itself, and whose numerical computation can be compared with high precision measurements in both space and time.

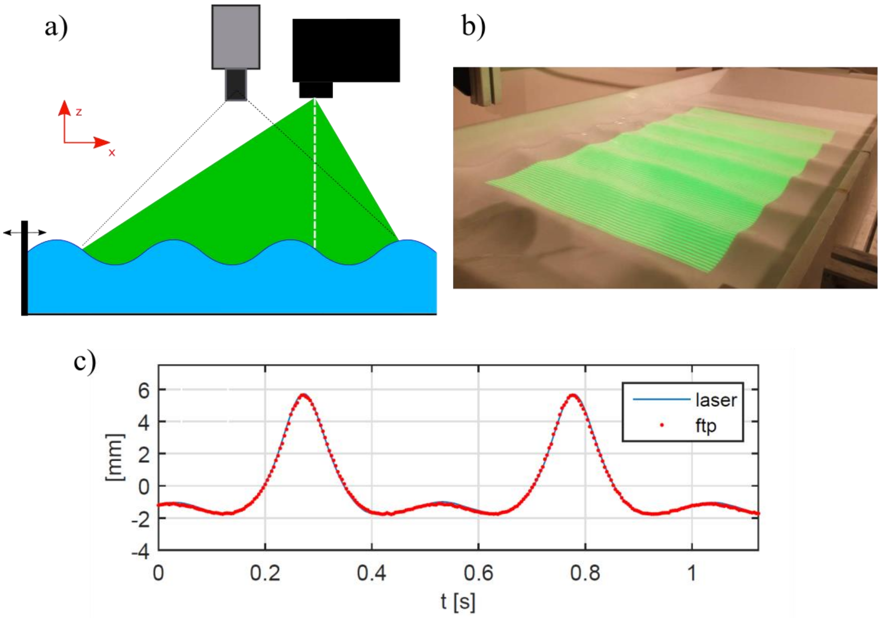

Figure 1: a) Sketch of the Fourier Transform Profilometry technique. b) Image of the experimental set-up: pattern projected onto a diffusive surface. c) Typical temporal experimental signal.

References:

[1] Monsalve, E.; Maurel, A.; Pagneux, V.; Petitjeans, P. (2022). Nonlinear Waves Passing over Rectangular Obstacles: Multimodal Method and Experimental Validation. Fluids, 7, 145.

[2] Euvé, L. P., Pham, K., Petitjeans, P., Pagneux, V., & Maurel, A. (2021). Time domain modelling of a Helmholtz resonator analogue for water waves. Journal of Fluid Mechanics, 920.

[3] Cobelli, P. J., Maurel, A., Pagneux, V., & Petitjeans, P. (2009). Global measurement of water waves by Fourier transform profilometry. Experiments in fluids, 46(6), 1037-1047.