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Development of Numerical Wave Tank Using Boundary Element Method with Cubic B-splines

Konstantin Kuznetsov (1), Jeffrey Harris (1), Christophe Peyrard (1,2), Amin Mivehchi (3), Stephan Grilli (3), and Michel Benoit (4)

(1) LHSV, Ecole des Ponts, CEREMA, EDF R&D, Université Paris-Est, Chatou, France, (2) EDF R&D, Laboratoire National d'Hydraulique et Environnement, Chatou, France, (3) Dept. of Ocean Engineering, University of Rhode Island, Narragansett, RI 02882, USA, (4) Institut de Recherche sur les Phénomènes Hors Equilibre (IRPHE),UMR 7342 (Aix-Marseille Univ., Ecole Centrale Marseille, CNRS), Marseille, France

We report on developments with a three-dimensional numerical wave tank for wave-structure interaction. A fully nonlinear potential flow approach is adopted and the resulting Laplace problems (one for the potential ϕ and one for its time derivative ϕ_t) are transformed into Boundary Integral Equations (BIE) and solved with a High Order Boundary Element Method (HOBEM). In particular, we present the algorithms regarding the implementation of cubic B-splines into the numerical wave tank, enabling significantly higher-accuracy in describing physical phenomena. Further, we show how the structure of the program is designed to integrate these developments with other numerical aspects such as the fast multipole method; different physical conditions, such as various wavemakers; and various options for improving solution stability. Calculations with steep regular waves impacting monopile and gravity based foundation and monopile are compared with laboratory experiments will be presented.