海岸和近海工程国家重点实验室
STATE KEY LABORATORY OF COASTAL AND OFFSHORE ENGINEERING

海岸和近海工程国家重点实验室
学术讲堂

题　目： **Advanced modeling of wave transformation and breaking over coastal seabed profiles with a fully nonlinear and dispersive potential model**

报告人： **Prof. Michel Benoit**

时　间： **2022年01月07日 15:30-16:30**

地　点： 腾讯会议房间号：**681 7974 9019**

内容简介：

Michel Benoit is currently senior researcher at the R&D division of Electricité de France (EDF). He works in the Laboratoire National d'Hydraulique et Environnement (LNHE) in Chatou, France. He was the founder and director (2008-2015) of Saint-Venant Laboratory for Hydraulics from Paris-Est Univ. He was appointed full Professor (2015-2021) at Ecole Centrale Marseille and Irphé in Marseille, France. His research activities cover (i) fluid mechanics in rivers, oceans and coastal seas, free surface waves, tsunamis, wave-current-atmosphere interactions, (ii) analysis multidirectional sea states, (iii) modelling waves, by using either phase-averaged approaches (developer of Tomawac spectral model) or phase-resolving approaches (Boussinesq-type models, HOS method, fully nonlinear potential flow Whispers3D code, etc.) He is author or co-author of over 170 papers, 1 collective book, 2 book chapters. His current H-index is 27 with 2,653 citations in total. He serves as associate editor of several journals: Applied Ocean Res., J. Ocean Eng. Mar. Energy and Frontiers in Marine Research. He has supervised 15 PhD thesis and 8 post-doc. fellows.

Abstract: To simulate coastal wave dynamics in variable bottom conditions, a fully nonlinear and dispersive potential flow model is being developed. The model is based on the time evolution of the free surface elevation and the free surface velocity potential. A spectral approach is used in the vertical direction, by decomposing the potential using an orthogonal basis of Chebyshev polynomials. By properly selecting the maximum order of these polynomials, an arbitrary level of accuracy can be achieved. Recently, depth-induced breaking dissipation has been implemented and validated against experiments. The mathematical theory and numerical methods will be briefly presented. Then, several validations cases will be discussed, including (i) the study of Benjamin-Feir instability of waves in uniform water depth, with Fermi-Pasta-Ulam-Tsingou (FPUT) recurrence, (ii) the propagation of nonlinear regular waves over a submerged bar (non-breaking and breaking cases), (iii) the generation of nonlinear harmonics on a submerged step, with effect of bulk dissipation and surface tension, (iv) the transformation of nonlinear irregular waves over a barred beach and a step-like bottom profile, with specific attention to the occurrence of extreme (freak) waves induced by abrupt water depth variations. All model results agree well with experimental data, confirming the model's ability to simulate accurately the evolution of nonlinear and dispersive regular and irregular wave trains, and associated statistical parameters and distributions, variance spectrum, bi-spectrum, etc.

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