Etudes expérimentales de l'influence de l'aération sur les impacts hydrodynamiques : deux configurations idéalisées avec présence de poches d'air et de bulles

Doctorant·e

BERKANE Belaid

Direction de thèse

PINON GRÉGORY (Directeur·trice de thèse)
PERRET GAELE (Co-encadrant·e de thèse)

Date de la soutenance

27/05/2024 à 14:00

Lieu de la soutenance

Amphithéatre LOMC Prony, 53 rue Prony, 76600 Le Havre

Rapporteurs de la thèse

CHATELLIER LUDOVIC MAÎTRE DE CONFERENCES (HDR) Université Poitiers
GERMAIN GRÉGORY CHERCHEUR (HDR) IFREMER - BOULOGNE-SUR-MER

Membres du jurys

ABADIE STEPHANE, PROFESSEUR DES UNIVERSITES, Université de Pau et des Pays de l'Adour
CHATELLIER LUDOVIC, MAÎTRE DE CONFERENCES (HDR), Université Poitiers
DEMOULIN FRANCOIS-XAVIER, PROFESSEUR DES UNIVERSITES, UNIVERSITE DE ROUEN NORMANDIE
GERMAIN GRÉGORY, CHERCHEUR (HDR), IFREMER - BOULOGNE-SUR-MER
PERRET GAELE, MAÎTRE DE CONFERENCES, Université Le Havre Normandie
PINON GRÉGORY, PROFESSEUR DES UNIVERSITES, Université Le Havre Normandie

Abstract

Hydrodynamic impacts between solid structures and liquids play a crucial role in various strategic fields such as coastal engineering, aeronautics, and renewable energy. This thesis focuses on the less explored effect of aeration, where the presence of air in the form of bubbles or air pockets significantly alters impact forces and hydrodynamic responses. The central objective of this thesis is to deepen our understanding of aeration's effects on complex hydrodynamic impact dynamics. This research concentrates on two distinct experimental setups: the impact of a flat plate on a calm water surface and the impact of an aerated water jet on a flat plate. The challenge is to examine how aeration influences impact pressures and post-impact oscillation frequencies. To achieve these objectives, experimental setups were designed for each case study. These model experiments allow us to precisely control crucial parameters such as impact velocity, plate dimensions, ambient pressure, etc. Special attention was also given to measuring aeration rates and impact pressures, enabling rigorous analysis of the results. For the plate impact, observations showed that maximum impact pressures and pressure impulses deviate from the von Karman theory, mainly due to the damping effect of air. Reducing ambient pressure increases impact pressures, suggesting a reduction of the air cushion effect. Regarding the impact of an aerated water jet, a diversity of flow regimes, such as bubble, slug, churn, and annular flows, were identified. The interaction between the number of injectors, air pressure, and bubble characteristics demonstrates a significant interdependence. The effects of aeration on impact pressures and oscillation frequencies show that larger structures induce slower oscillations and increased dimensionless pressures.