PIV measurements of breaking waves

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Motivation: Predicting forces from breaking waves

Kriegers Flak offshore wind farm. Photo credit power-technology.com/

Monopole foundation Photo credit 4coffshore.com
PIV measurements of breaking waves

Experimental PhD study
• Initiated September 2015
• Currently trying out concept
• To be finished June 2019

Objectives
• Measure kinematics under breaking waves
• Use for validating CFD models

Kriegers Flak offshore wind farm. Photo credit power-technology.com/
Wave kinematics under breaking waves

PIV measurements of breaking waves
Wave kinematics under breaking waves

[Diagram of wave kinematics with PIV area, wave flume, camera, laser, and mirror setup.]

PIV measurements of breaking waves
PIV measurements
Small wave on sloping bed

Water depth $h = 0.20$ m
Wave height $H = 0.03$ m
Wave period $T = 1.0$ s
Small wave on sloping bed

Water depth \( h = 0.20 \text{ m} \)
Wave height \( H = 0.03 \text{ m} \)
Wave period \( T = 1.0 \text{ s} \)

\[
\frac{\partial u}{\partial t} = -u_{i+2} + 8u_{i+1} - 8u_{i-1} + u_{i-2} \quad \Delta t
\]

- Linear theory + Wheeler stretching
- PIV measurement
Spilling breaker on sloping bed

- Water depth $h = 0.20 \text{ m}$
- Wave height $H = 0.17 \text{ m}$
- Wave period $T = 1.5 \text{ s}$

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Linear theory + Wheeler stretching

PIV measurement
Future plans

2017
• Irregular waves
• Slope 1/10, 1/50

2018
• Measure forces on a model monopile
PIV measurements of breaking waves

- Predict forces from breaking waves
- Validation of CFD models
- New PIV measurements can shed light on wave kinematics
Questions