INTRODUCTION

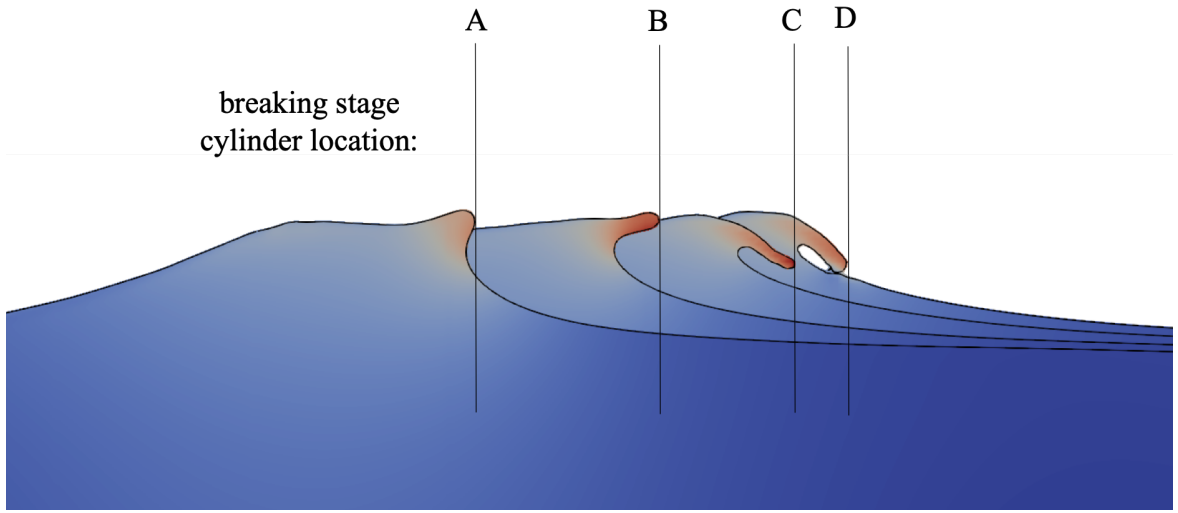


Figure 1 Four typical breaking scenario

PURPOSE

1. Accurate prediction of the hydrodynamic loads on single cylinder

2. Interaction of the breaking wave and monopile under different breaking scenario

II NUMERICAL MODEL

REEF3D : Open-Source Hydrodynamics

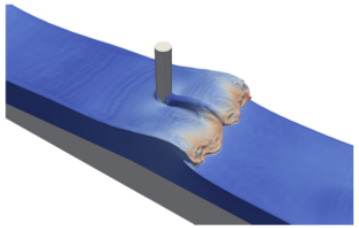
- Developed at the Department of Civil and Environmental Engineering, NTNU Trondheim

Multiscale Framework:
- high-order discretization (FDM)
- mesh with immersed boundary
- high-performance solvers
- consistent parallelization (MPI)

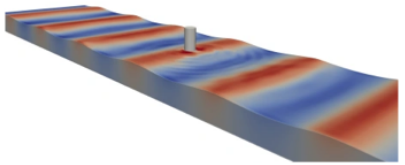
Multiphysics for Hydraulic, Coastal, Offshore:
- sediment transport
- floating bodies
- porous structures
- vegetation
- stratified flow

- Published under GNU GPL v3

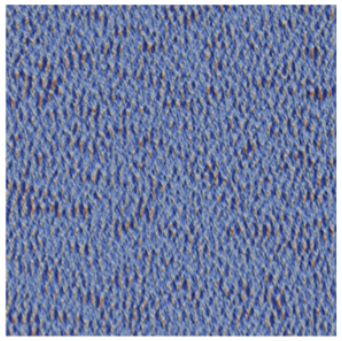
www.reef3d.com



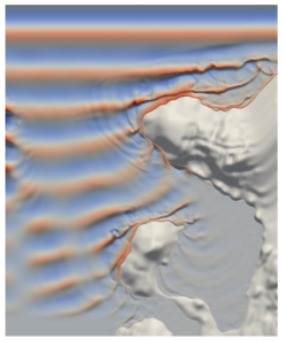
CFD: Two-Phase Navier-Stokes Equations



NSEWAVE: One-Phase Navier-Stokes Equations



FNPF: Fully Nonlinear Potential Flow



SFLOW: Non-hydrostatic SWE

x

Used in this Study: CFD

$$\frac{\partial U_i}{\partial x_i} = 0$$

$$\frac{\partial U_i}{\partial t} + U_j \frac{\partial U_i}{\partial x_j} = -\frac{1}{\rho}\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j}\left[(\nu + \nu_t)\left(\frac{\partial U_i}{\partial x_j} + \frac{\partial U_j}{\partial x_i}\right)\right] + g_i$$

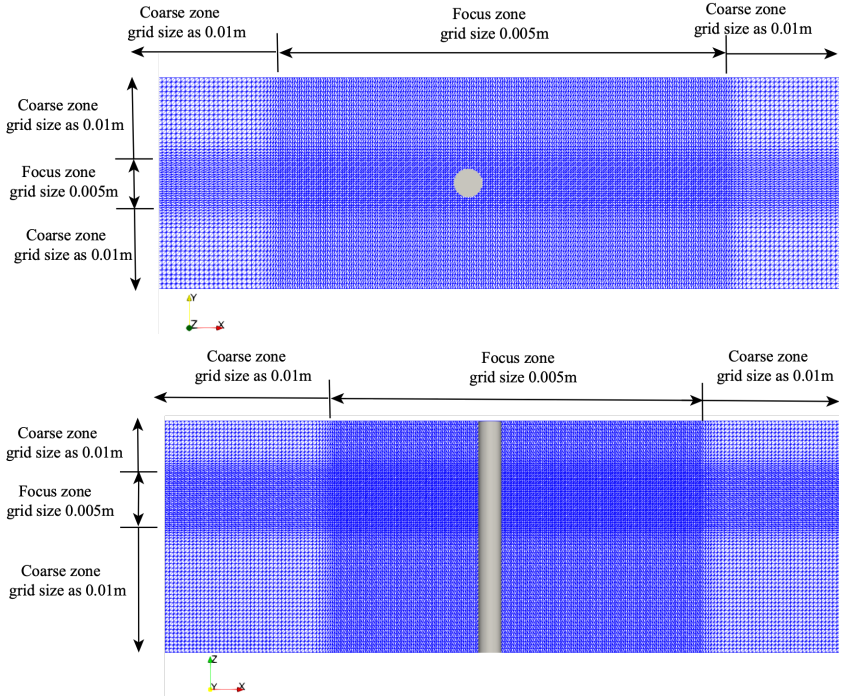
temporal disc.	3rd-order RK
spatial disc.	5th-order WENO
pressure	PJM
turbulence	RANS & LES

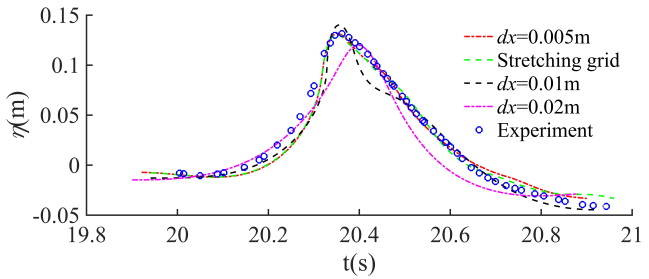
Forces:

$$F = \int_{\Omega} (-\mathbf{n}P + \mathbf{n}.\tau) d\Omega$$

III RESULTS and DISCUSSION

a. Grid Setting and convergency study



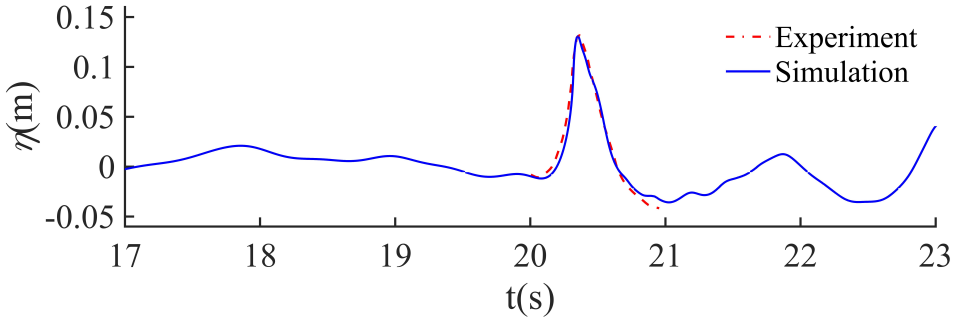


Grid convergency study

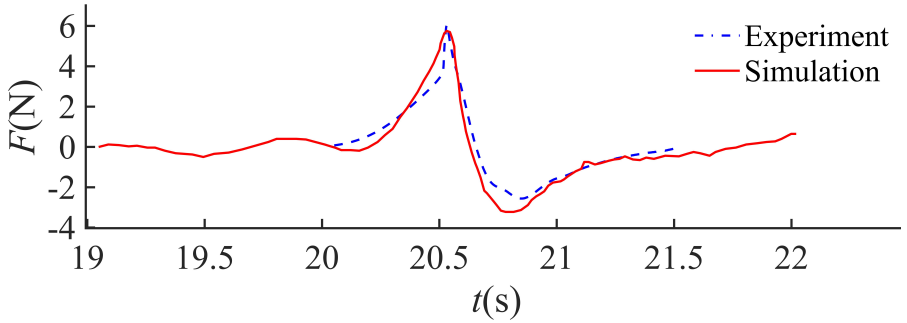
b. Model Validation

Comparison with experiment results carried out by Tai, B., Ma, Y., Niu, X., Dong, G., and Perlin, M. in DUT.

Case stageA-Validation case



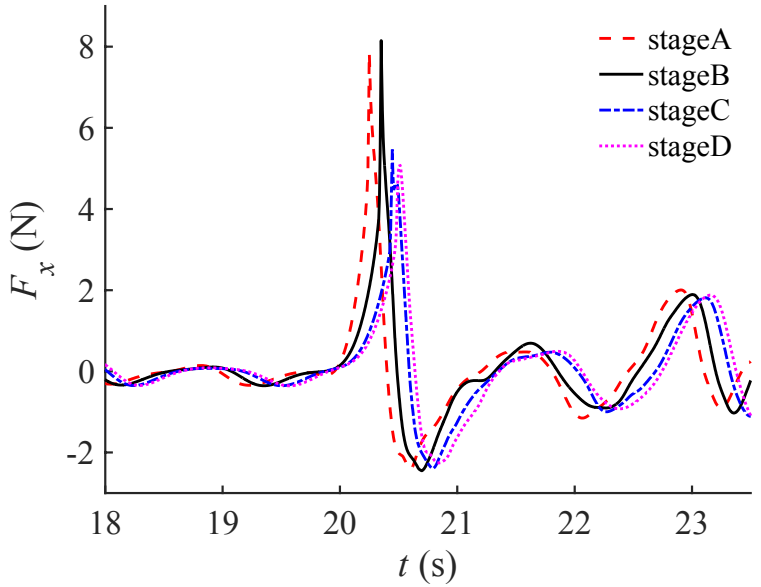
•Comparison of wave elevation



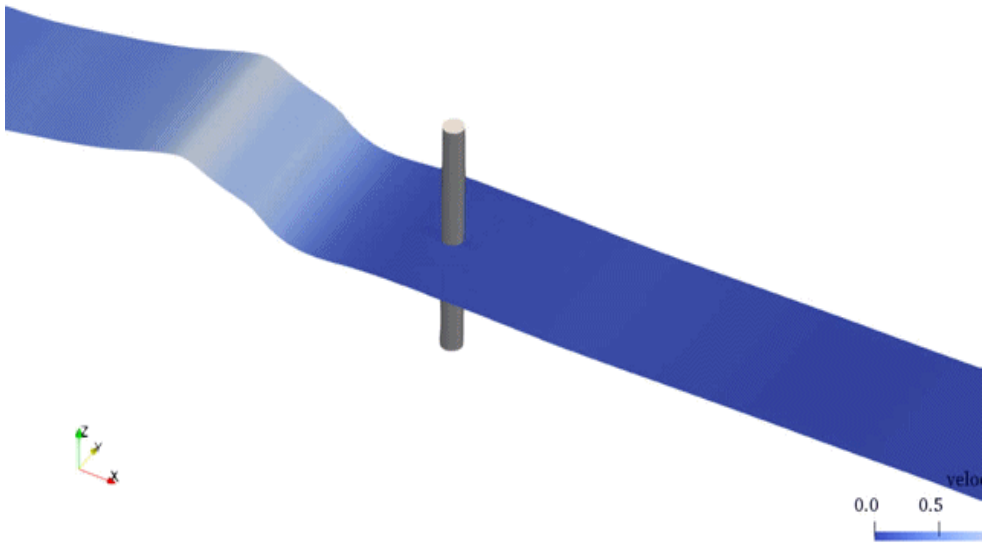
•Comparison of wave forces

III RESULTS and DISCUSSION

Part 3 : Wave breaking force analysis



F_{all} (Total force) of four breaking scenario



The maximum of wave runup on cylinder surface can reach around 30% to 45% of the wave elevation and corresponds to time section when the maximum breaking force occuring.

The breaking dynamic force under the scenario during the plunging jet developing (stage A and stage B) is apparently bigger than the scenario after the jet started move downwards