VERIFICATION OF MULTI DIRECTIONAL WAVE GENERATION BASED ON THREE-DIMENSIONAL NUMERICAL WAVE TANK

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INTRODUCTION

Although it is still tricky to stably solve multi-directional irregular waves using a three-dimensional numerical wave tank, several studies have been carried out in recent years with the development of computers (e.g., Wang et al., 2019). In order to calculate stable multi-directional irregular waves, it is necessary to devise the incident boundary conditions.

In this study, the wave generation source model (Yamano et al., 2010), which can generate waves in the calculation domain, was applied to verify the stable multi-directional irregular wave generation based on 3D Navier-Stokes simulations. At first, it was verified whether unidirectional irregular waves could be generated or not. Next, multi-directional irregular waves were verified. The calculation time was also summarized.

METHOD

CADMAS-SURF/3D (Arikawa et al., 2019, named as CS3D) is used as a three-dimensional fluid calculation model based on the Navier-stokes equation. In the wave source model, the source for wave generation is set at the center of the specified cell (Figure 1). Since the wave source model is not a method to directly specify the velocity and water level, reflected waves from structures or slopes can be passed through the source.

The phase difference can be obtained from the relative position between wave direction and each wave making source cell and oblique waves are generated by giving the velocity that takes the phase difference into account. The Sokes drift is subtracted from the horizontal velocity. In this paper, Bretschneider-Mitsuyasu formula is used.

RESULTS AND DISCUSSION

At first, A basic examination was conducted to verify whether the total volume adjustment works or not. Figure 2 shows the wave profile in the flume with a flat bottom. The profile in 2(a) is calculated without adjustment and one in 2(b) is adjusting due to Stokes drift. The result of the total volume in 2(c) showed that the adjustment worked well.

Next, multi-directional irregular wave generations were verified. Figure 3 shows the wave profile difference due to Smax, a dimensionless frequency parameter. Finally, the effective test area was verified.

CONCLUSION

The wave generation source model was applied to CS3 to construct a digital water basin that is stable with a wide effective test are for multi-directional irregular waves. This method can eliminate the Stokes drift to adjust the total volume in the flume. Multi-directional irregular waves of the Bretschneider-Mitsuyasu type spectrum were generated and their validity was confirmed.

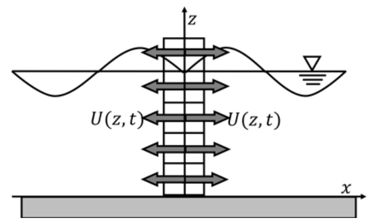

Figure 1 - Schematic of wave generation source model

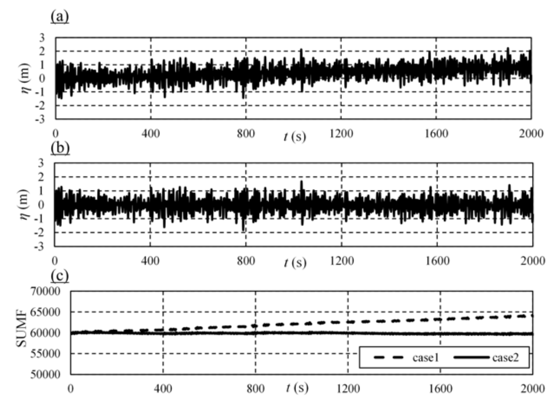

Figure 2 - Time history of wave profiles and the total volume effect of the subtracting the Stokes drift((a): case 1, without subtracting, (b): case2, with subtracting, (c): the total volume in flume)

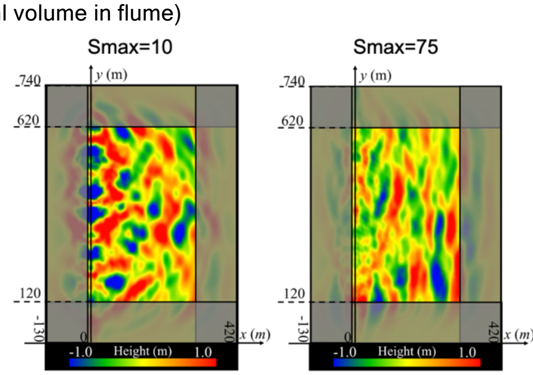

Figure 3 - Wave profile snapshots (Left: S_{max}=10, Right: S_{max}=75)

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