



Optimization of an oscillating wave surge converter

H2DOC - ENVIRONMENTAL HYDRAULICS AND HYDROLOGY

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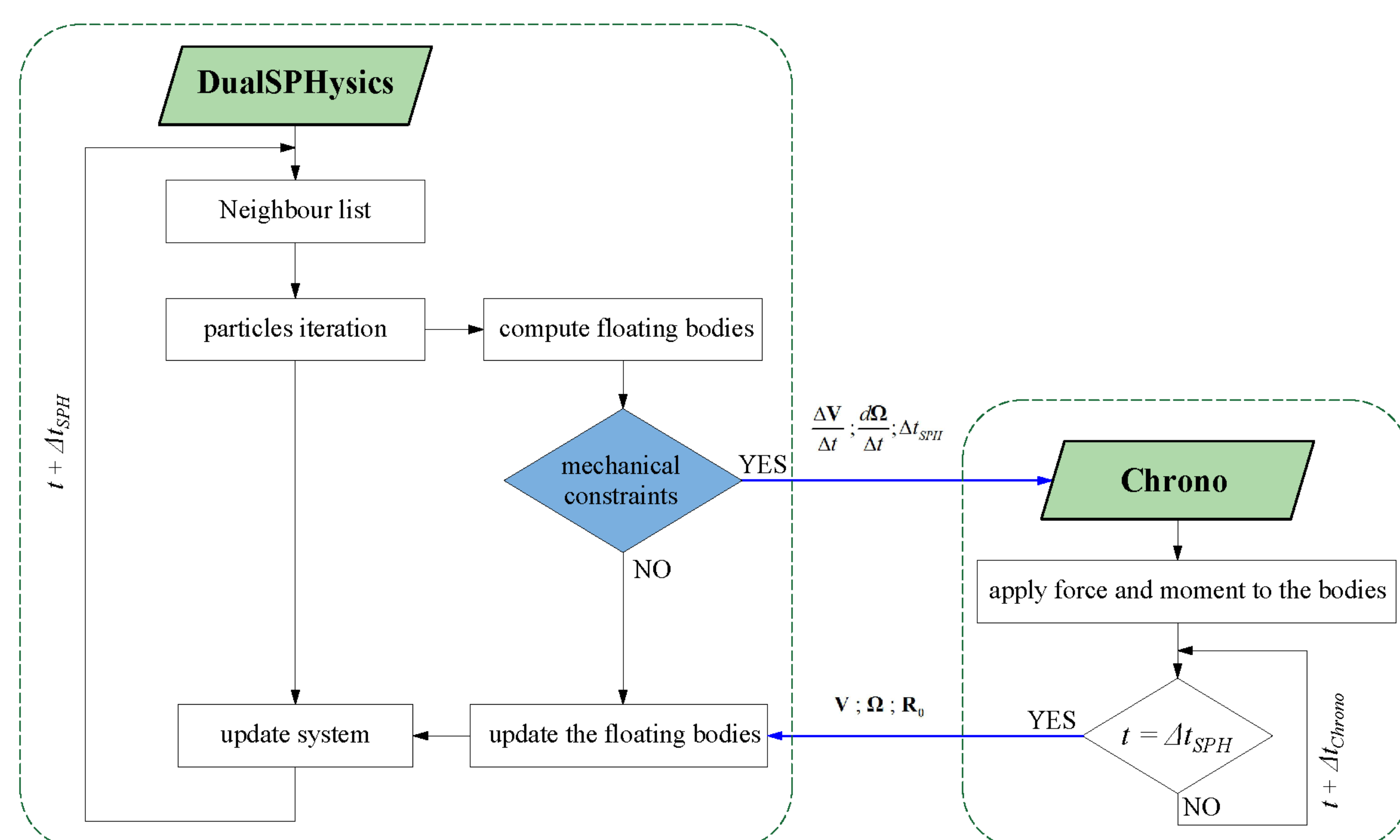
Motivation

Oscillating wave surge converters (OWSC) are a promising technology in the nearshore regions. However, currently, the characteristics of the flow action on the flap, especially the phase relation between the driving force and flow quantities such as velocity or free surface elevation, have not been investigated in detail. Moreover, design of OWSC requires tools that allows analyze the iteration fluid-flap and gives direct access to overall hydrodynamic loads. This work provides a new, fully coupled, robust numerical model for multiphysics simulations of wave energy converters (WECs).

Numerical model

Mesh-free DualSPHysics is considered for fluid descriptions and Chrono for mechanical systems. DualSPHysics is a hardware accelerated Smoothed Particle Hydrodynamics (SPH) open-source code, that allows modelling interactions fluid-flap with extreme deformations and complex topological evolutions. Chrono is a platform-independent, open-source physics-based modelling and simulation infrastructure. This code allows straightforward definition of a large number of mechanical constraints.

Coupling between DualSPHysics and Chrono



DUALSPHYSICS-CHRONO: Diagram of the coupling procedure.

Numerical implementation is mainly split in three steps:

i) DualSPHysics computes the particles interaction (fluid-bodies) according to:

$$M \frac{dV}{dt} = \sum_{k \in FFB} m_k f_k$$

$$I \frac{d\Omega}{dt} = \sum_{k \in FFB} m_k (r_k - R_0) \times f_k$$

ii) Linear and angular acceleration to be applied in the centre of gravity of the bodies are transferred to the Chrono. During that time step, Chrono solves the motion considering the given mechanical constraints and the new position of centre of gravity and the linear and angular velocities are transferred back to DualSPHysics in order to update the position of the particles that form the bodies:

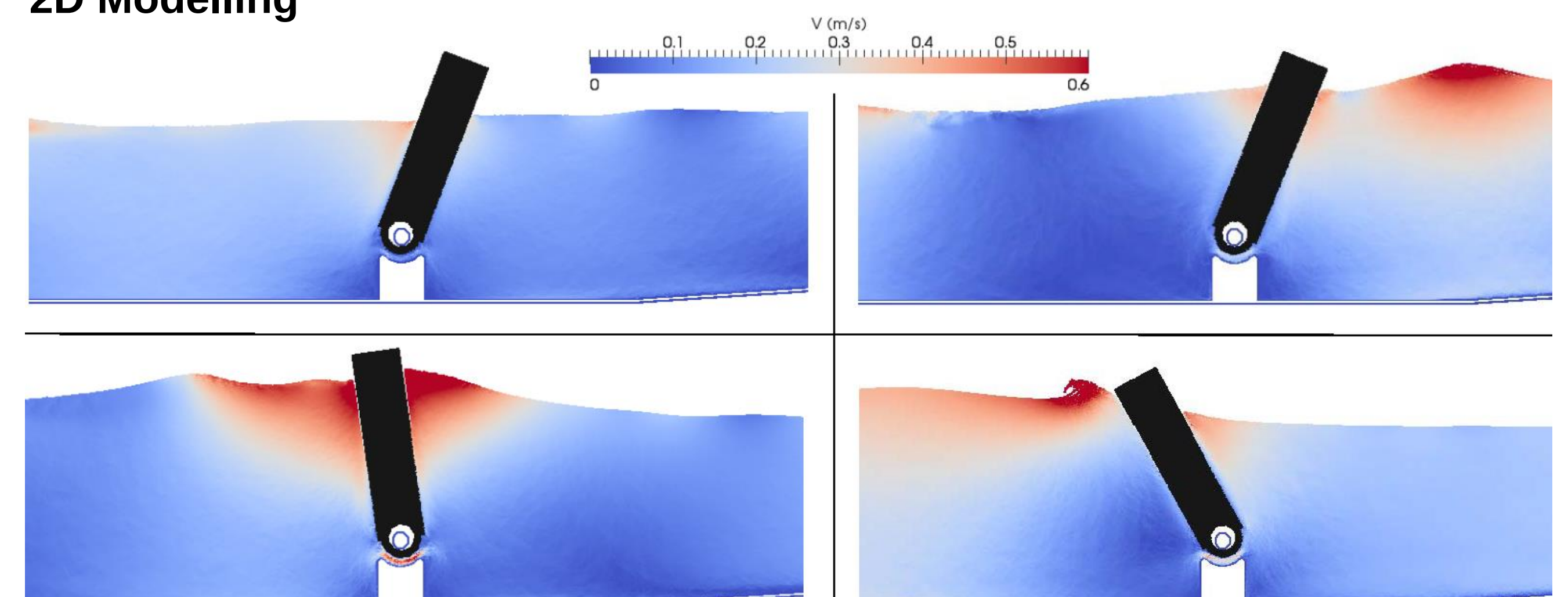
$$u_k = V + \Omega \times (r_k - R_0)$$

iii) DualSPHysics updates the variables of the system at the new time step.

Results

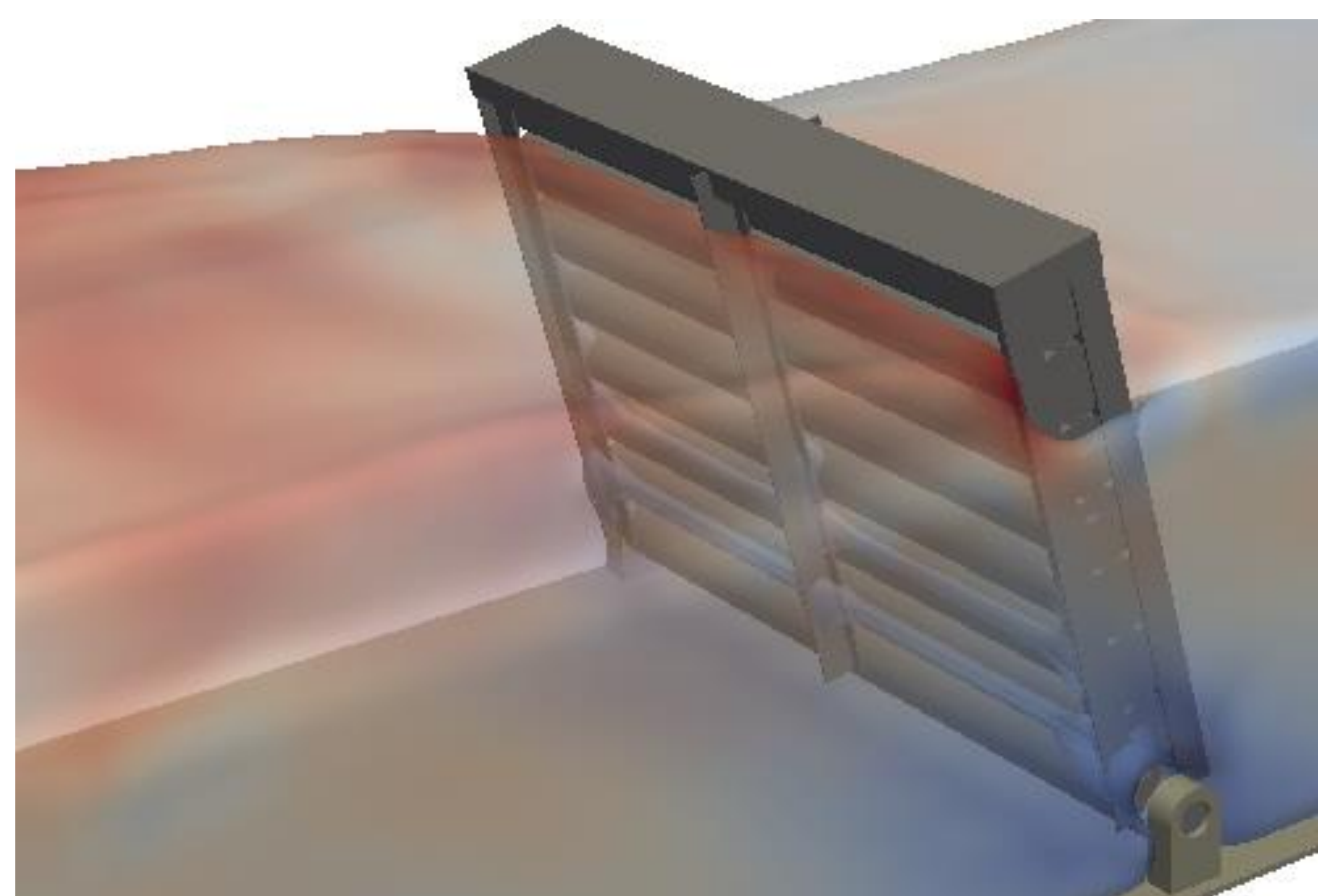
The numerical model was tested by describing the motion of OWSC.

2D Modelling



MODELLING OF OWSC: Different instants of 2D velocity field.

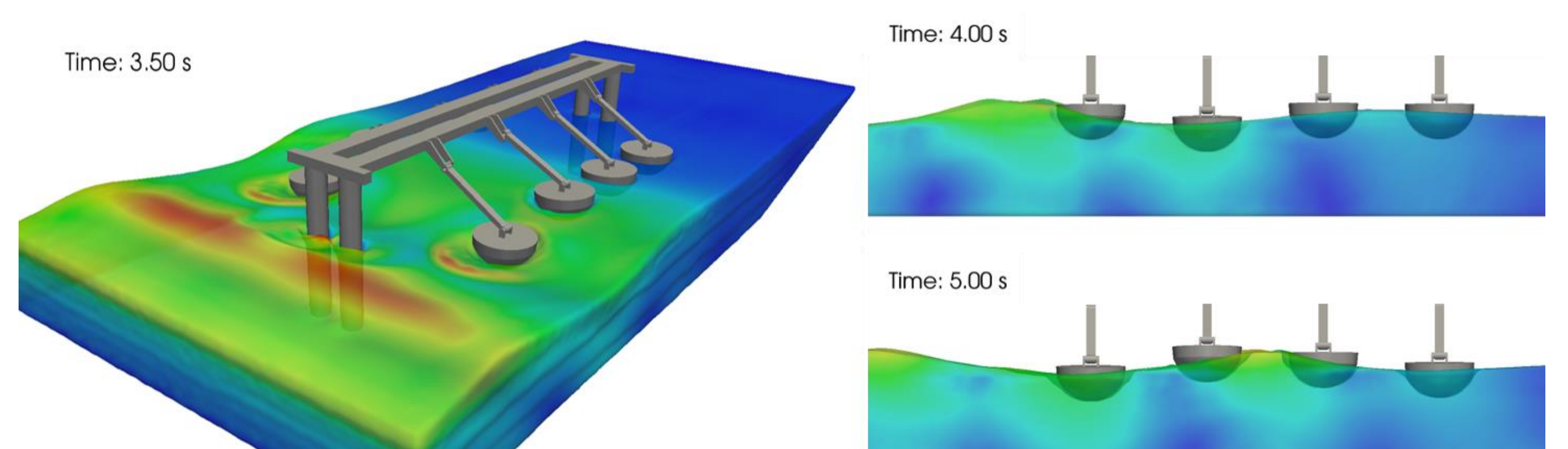
3D Modelling



MODELLING OF OWSC: 3D velocity field.

Conclusion

The proposed model can be useful from the engineering point of view. It can be applied to study OWSC, but also other multiphysics complex systems. Many different devices or technologies related with WECs can be simulated with this model.



EXAMPLE OF A COMPLEX SYSTEM: Wave Star device.