Large-Eddy Simulation of an Internal Ship Air Cavity in Model Scale

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ABSTRACT

Air lubrication is a technology promising to allow for a 15-20% reduction in the drag of a ship hull through covering a part of the wetted surface with an air layer [1]. Although prototypes of large displacement air-cavity ships have been successfully tested, further proof of the concept's feasibility for oceanic operations is necessary in order for it to be adopted for commercial projects [1]. In this work, simulating an internal air cavity in model scale is considered, see the left plot in Figure 1 for a schematic overview of the case geometry. The focus is on accurately resolving the transient flow close to the beach wall, in order to analyse the process of the discharge of air. To this end, an implicit large-eddy simulation is conducted, with the volume of fluid method used for capturing the air-water interface.

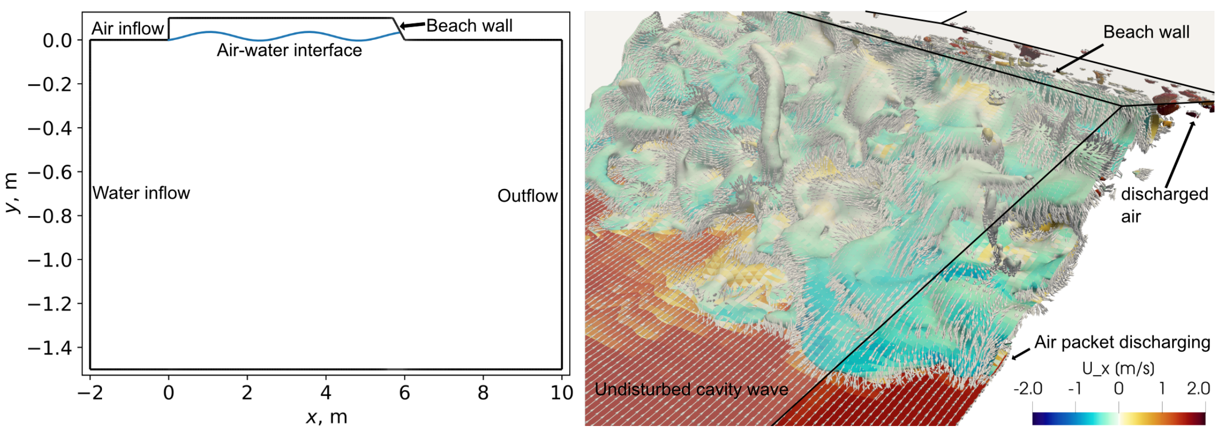

Figure 1: *Left:* Schematic view of the case geometry. *Right:* A snapshot of the air-water interface close to the beach wall, arrows show the direction of the flow.

Previous study of external air cavities [2] proposed that one of the primary reasons for the discharge of air is a re-entrant jet, which continuously sheds off air packets in the closure region. Preliminary results from the internal cavity simulations conducted here indicate that air discharge occurs via a different mechanism. Analysis reveals a highly unsteady reverse flow present near the beach wall (see the right plot in Figure 1), leading to the formation of a shear layer, across which air entrainment occurs. This work will focus on further characterising the air discharge mechanism and its dependency on the configuration of the cavity.

REFERENCES

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