Abstract

This PhD concerns laboratory wavemaking in shallow and intermediate water conditions. Theoretical solutions and experimental evidence are presented to advance both our understanding of the wave generation process as well as its practical success. A comparison is made between two wave generation techniques, a first based on controlling the wavemaker displacement, and a second based on controlling the wavemaker force.

In deep water, a force-based approach, which includes active wave absorption, was recently shown to offer benefits in terms of wave quality. To investigate the influence of the water depth on this type of control, a range of generation scenarios is considered, including regular, bi-chromatic, focused and random waves. The work demonstrates that force-based wave generation in shallow water suffers from similar limitations as position control. This principally concerns the contamination of the testing area due to unwanted free waves, where the present focus is placed on the superharmonic range.

The main advance of the work lies in the solutions it offers to overcome this free wave contamination. The nature of the nonlinear wave solution upon which force-based generation should be based depends on the type of wave case (regular, bi-chromatic, focused or random). For each of these cases, a suitable methodology is proposed and validated. The developed methodology allows for high quality wave generation, whilst maintaining the benefit of active wave absorption.

The work is timely in the sense that is responds to two recent developments. First, the majority of wavemaking facilities are now computer controlled, and active absorption has become commonplace. The work presented offers solutions highly relevant to such installations. Second, developments particularly in offshore wind, have seen many new structures placed in relatively shallow-water depth. It is essential that the model testing of such structures adequately accounts for the issues and solutions presented herein.