# Evolution of Modulated Surface Water Waves through Counter- and Co-Currents Generated by Vertically-Impinging Plane Jets

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The interaction of modulated surface water waves with currents is of great interests to practical applications in environmental coastal engineering. Depending on current characteristics, the interaction is dominated by advection for deep current or by shear for shallow current, and also on the current directions. In this study, experiments were conducted to examine the evolution of modulated gravity waves with counter-and co-currents. The experiments were carried out in a wave channel of 6m long and 0.4m wide, with a water depth of 0.4m. Modulated waves were generated at one end of the channel to propagate toward a beach at the other end. The currents were generated by a submerged vertical turbulent plane jets at the center of the wave channel. Therefore, both the effects of counter- and co-currents on the evolution of modulated surface gravity waves can be studied in this experiment. The current velocity field was measured with an LDV system and the surface wave with a wave height gauge. The LDV measurements show the non-uniformity in the velocity profiles with shear as a result of developing horizontal surface jets along the channel. The depth of the surface current has the same order of the spreading width of surface jet. The evolution of wave field in terms of wave amplitude and wave number along the channel was deducted from the wave signals using fast Fourier transform (FFT) and Hilbert-Huang transform (HHT). The experimental results show that, in a counter-current wave system, the wave number increases in the surface velocity dominated regime and decrease in the shear dominated regime. Opposite result for a co-current wave system was observed. Similar results were also observed for the variation of the wave amplitude. The development of sidebands was greatly influenced greatly by the currents and depends on the current directions.

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