Nonlinear analysis of bore-shaped waves from wave-flume experiments

Presented by Sebastian Ujvary

ABSTRACT:

Undular bore waves are generated in the wave flume at the National university of Singapore. These waves have long periods and need much time and space to show their complete propagation and evolution. The phenomenon of undular bore waves transforming after some propagation time into a train of solitons is further analysed.

The conducted data of the experiments is analysed in the time-domain and frequency domain.

The flume at NUS does not offer enough propagation distance for the bore waves to develop completely into a train of solitons. Due to the limited flume length, the numerical model of COULWAVE, based on the Boussinesq equation, is utilised to simulate the bore wave propagation for longer distances. The result of a COULWAVE simulation of a bore wave is a train of solitons, providing the complete free-surface elevation data.

The Nonlinear Fourier Transform based on the Korteweg and deVries equation is able to analyse free-surface data in frequency-domain for underlying nonlinear processes. The application of this model on the free-surface elevation data that contains undular bore waves, provides the information of the solitons; amplitude and amount.

The mainly analysed input data is the free-surface elevation data of the undular bore waves in their early stage of about 5 m propagation. After applying both processes on the same undular bore wave data, the resulting soliton amplitudes and numbers result in high similarity, about 95 %.

Furthermore, the conducted results support the theory of the relation between the final soliton amplitude and the average bore plateau height. The leading soliton of the soliton train is about the doubled height of the average bore plateau height.

Utilising two independent analyses that are based on different theories, strengthen the models KdV-NLFT and COULWAVE that result in similar results.