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# The New Year Wave: Generation, Propagation, Kinematics and Dynamics - Registered in a Seakeeping Basin

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In the past years the existence of freak waves has been affirmed by observations, registrations, and severe accidents. One of the famous real world registrations is the so called "New Year wave," recorded in the North Sea at the Draupner jacket platform on January 1st, 1995. Since there is only a single point registration available, it is not possible to draw conclusions on the spatial development in front of and behind the point of registration, which is indispensable for a complete understanding of this phenomenon. This paper presents the temporal and spatial development of the New Year Wave generated in a model basin.

To simulate the recorded New Year wave in the wave tank, an optimization approach for the experimental generation of wave sequences with predefined characteristics is used. The method is applied to generate scenarios with a single high wave superimposed to irregular seas. During the experimental optimization special emphasis is laid on the exact reproduction of the wave height, crest height, wave period, as well as the vertical and horizontal asymmetries of the New Year Wave. The fully automated optimization process is carried out in a small wave tank. At the beginning of the optimization process, the scaled real-sea measured sea state is transformed back to the position of the piston type wave generator by means of linear wave theory and by multiplication with the electrical and hydrodynamic transfer functions in the frequency domain. As a result a preliminary control signal for the wave generator is obtained. Due to nonlinear effects in the wave tank, the registration of the freak wave at the target position generated by this preliminary control signal deviates from the predefined target parameters. To improve the target wave in the tank only a short section of the control signal in time domain has to be adapted. For these temporally limited local changes in the control signal, the discrete wavelet transformation is introduced into the optimization process which samples the signal into several decomposition levels where each resulting coefficient describes the control signal in a specific time range and frequency bandwidth. To improve the control signal, the experimental optimization routine iterates until the target parameters are satisfied by applying the subplex optimization method. The resulting control signal in the small wave tank is then transferred to a large wave tank considering the electrical and hydrodynamic RAOs of the respective wave generator.

The extreme sea state with the embedded New Year Wave obtained with this method is measured at different locations in the tank, in a range from 2163 m (full scale) ahead of to 1470 m behind the target position—520 registrations altogether. The focus lies on the detailed description of a possible evolution of the New Year Wave over a large area and time interval.

The analysis of the registrations reveals freak waves occurring at three different positions in the wave tank and the observed freak waves are developing from a wave group of three waves, which travels with constant speed along the wave tank up to the target position. The group velocity, wave propagation, and the energy flux of this wave group are analyzed within this paper.