WIND WAVES MODELLING - ACTUAL APPROACHES

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During the last 20 years there has been a strongly growing economic and scientific interest in the sea. This has led to substantial improvements in all the related fields, due also to the contemporary technological developments. Large efforts have been devoted particularly to the prediction of the sea state, both for real time forecast as for hindcast.

One of the main applications of hindcast is the collection of large sets of wave data from the past. The designers of marine structures require the estimate of the maximum sea conditions likely to happen during the foreseen lifetime of the structure. These are usually obtained from a series of data long enough to ensure reliable statistical extrapolation. Unluckily the necessary length of the series (10-20 years) is hardly available at the location of interest. The technique is therefore to look at the worst storms of the last 10 or 20 years, estimating the corresponding sea conditions by theoretical models. The wave data so obtained are then used in the statistics to obtain the required design conditions.

Reliable models are required for the correct evaluation of the maximum wave conditions during each storm. The actual wind wave models can be substantially divided into two categories, 1) spectral and 2) parametric ones.

In spectral models of the grid type the energy present at each grid point at a given instant derives from the sum of that present at the previous instant, that advected with the waves field and the input from the wind, the last two being positive or negative according to the situation. At each point n frequencies and m directions are considered, so at each time step a set of m x n differential equations has to be solved at each grid point.

The large computer time necessary for this procedure has pushed towards the alternative parametric approach. Here, under some basic physical assumptions, the energy differential equation is projected into the parameters space, and the number of equations to solve at each time step equals that of the used parameters. This is usually quite limited, 3 at the most in the actual models, which drastically reduces the necessary computer time and makes the hindcast method economically usable for engineering purposes.

The described models work on a large scale basis and for most of them deep water conditions are assumed. If the results have then to be transferred at the coast, we have to take local coastal shape and bottom topography into account. The right tool for this step is a spectral model using the ray technique, where the attention is focused at the position of interest, and it is possible to take refraction and shoaling into account.