NEURAL NETWORK PREDICTION OF WAVE OVERTOPPING AT COASTAL STRUCTURES

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The crest height of coastal structures depends highly on the permissible overtopping discharge. This is the volume of sea water which is allowed to pass over the crest of the seawall or breakwater. As there is a general trend of sea level rise and climate change, overtopping is often larger than expected. This results in the damaging of buildings and cars or even worse, it sometimes results in injured or dead people who were on or close behind the sea defence at the moment of the storm. To provide the safety of coastal regions and their population now and in the future, it is essential to be able to predict the overtopping discharge under certain storm conditions as accurate as possible.

The objective of this study is therefore to develop a generic prediction method for overtopping at breakwaters and seawalls. The neural network technique, a technique which is able to recognize patterns in large and complex data sets, will be used to realize such a prediction method. A neural network needs a homogenous database, consisting of lots of known data, to 'train' the network, what means that the neural network 'learns' the relation between input and output with the aid of the database.

During the last 20 years, different universities and research institutes all over the world have performed detailed laboratory tests on overtopping at coastal structures. In these tests a scale model of a breakwater or seawall is constructed in a wave flume or tank and overtopping discharges are measured under a known wave attack. So, as lots of data are available, the first task was to gather as much of these data as possible. Twenty four different institutions in 11 different countries have delivered information about their overtopping tests. Actually (January 2003), over 7000 tests have already been gathered and more data are still expected. The parameters which are gathered in the database and which will be used as input in the neural network, are on the one hand hydraulic parameters such as wave height, wave period and angle of wave attack, on the other hand structural parameters to schematize an arbitrary overtopping section such as freeboard and crest width. One output parameter for the neural network is gathered in the database: the overtopping discharge q.

To get a homogeneous database, all these data needed to be screened. By studying the reports of the performed tests carefully, e.g. the measurement methods (measurement of the waves, measurement of the overtopping discharge) and the methods of analysis (e.g. the determination of incident wave characteristics), the reliability of the tests could be evaluated. Also uncertainties or errors could be detected in this way.

At this moment, all gathered data are screened so the development of the neural network can be started. The network will be developed in Matlab, a software program with a 'neural network toolbox'. After training and validation of the neural network with the homogeneous database, the network will finally provide the mentioned generic prediction method for overtopping at coastal structures.