Neural networks for prediction of wave overtopping

Introduction

Coastal structures are designed to protect (often densely populated) coastal regions against wave attack, storm surges, flooding and erosion. The crest height plays a predominant role in the protective function of these structures. The amount of sea water transported over the crest of a coastal structure, referred to as 'wave overtopping', is a critical design or safety assessment factor in the context of sea level rise.

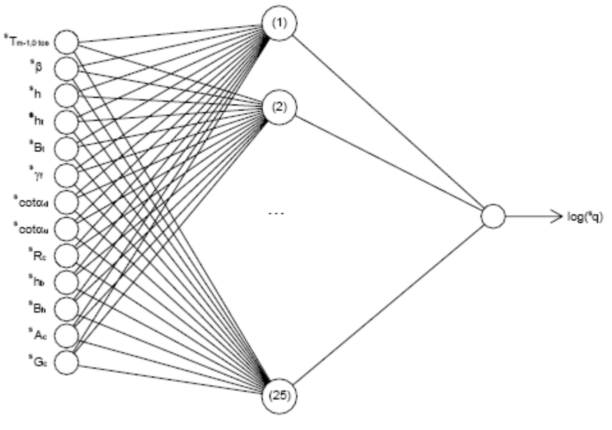
Prediction methods for wave overtopping

There is a lack of reliable and robust prediction methods for wave overtopping at all kinds of coastal structures. Most frequently applied for structure design are empirical models, set up based on laboratory overtopping measurements. However, such models can only be applied within a restricted range (i.e. the test range of the data on which the model is based), and only a single structure configuration is covered. In addition, it is hard to find suitable prediction methods applicable for structures not having a standard structure geometry. Finally models developed until now use a restricted number of wave parameters and structural parameters to predict mean overtopping discharges. The fact that each model is valid for only one specific structure type contributes to this. Considering various proposed overtopping models, it is seen that overtopping is influenced by many wave and structure characteristics.

Neural Networks

Artificial neural networks, often simply called neural networks (NNs), fall within the field of artificial intelligence. They can be defined as systems that simulate intelligence by attempting to reproduce the structure of human brains and can be trained on given input-output patterns. Typically, NNs consist of many inputs and outputs what makes these attractive for modeling multivariable systems and establishing nonlinear relationships between several variables in large databases. NNs have been applied successfully in various fields of coastal engineering research.

Motivated by the findings above, a 2-phases neural model which predicts wave overtopping at a variety of structure types and with an extensive range of applicability, was developed at the Department of Civil Engineering at Ghent University. The generally applicable overtopping model is composed of two neural networks: a so-called 'classifier' followed by a so-called 'quantifier'. Both networks are trained with the extensive, screened overtopping database set up within the CLASH project (Verhaeghe, 2005; Van der Meer et al., 2007).



Verhaeghe, H., 2005. Neural network prediction of wave overtopping at coastal structures, Ph.D. Thesis, Universiteit Gent, Gent, Belgium, ISBN 90-8578-018-7 (available on: http://www.clash-eu.org)

Van der Meer, J.W., Verhaeghe, H., Steendam, G.J., 2007. The new wave overtopping database for coastal structures, submitted for Special Issue of Coastal Engineering on the CLASH project (database available on: http:// www.clash-eu.org)

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