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PII: S0925-2312(17)31770-8
DOI: 10.1016/j.neucom.2017.07.070
Reference: NEUCOM 19076

To appear in: Neurocomputing

Received date: 30 January 2017
Revised date: 27 June 2017
Accepted date: 31 July 2017


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A Hermite Neural Network Incorporating Artificial Bee Colony Optimization to Model Shoreline Realignment at a Reef-Fronted Beach

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Abstract

This paper investigates the potential of using a novel Hermite polynomial neural network to model shoreline realignment along an urban beach fronted by a highly irregular beachrock reef. Modeling takes place on the basis of a number of input variables related to reef morphology and wave forcing, whereas the output variable is time series of shoreline position that have been recorded in high spatio-temporal resolution using a coastal video monitoring system. The main network functionality is the generation of Hermite truncated polynomial series of linear combinations of the input variables, and output is calculated as the weighted sum of these truncated series. It is shown that the proposed network can approximate any continuous function defined on a compact set of the multidimensional Euclidean space to arbitrary accuracy. The network is optimized in terms of a modified artificial bee colony method. For comparative reasons, three more related neural networks have been tested that have been optimized by employing different swarm intelligence-based algorithms. Comparison between the four networks has been carried out by standard performance criteria and detailed parametric statistical analysis. Main results of the study are: (a) polynomial orders 3 and 4 are able to effectively handle reasonably well the high nonlinear effects imposed by the presence of the reef; (b) the statistical analysis indicates that the proposed network outperforms the other networks tested; and (c) model efficiency improves noticeably when beach sections behind
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