AOGS 2005

Computer-Aided Knowledge Discovery: A Case Study in Vegetation Induced Resistance Coefficient

VLADAN BABOVIC[1] MARTIN BAPTIST[1] and MAARTEN KEIJZER[1]
[1]*WL| Delft Hydraulics, Delft, The Netherlands*

Proper modelling of flow in wetlands and vegetated floodplains is of great practical importance. Many research initiatives have been undertaken in order to improve on the description of the relationship between flow resistance and the presence and spatial distribution of vegetation. Both analytical and experimental studies of vegetation-related resistance to flow and the equivalent resistance coefficients have shown that the resistance coefficients are water-depth dependent. Consequently, the traditional approach of using a single resistance coefficient fails to correctly describe the physics of the phenomenon. One way of improving upon this description is updating the equivalent resistance coefficient based on the computed water depth. In order to do so, a relation between vegetation characteristics, bed resistance, water depth and equivalent resistance coefficient is needed.

Two main approaches for creating such an equation are contrasted in this paper. The first approach is the time-honoured method where a scientist uses knowledge is available about the physics of the phenomenon and assembles an equation based on detailed understanding of the phenomena involved in the process. This understanding takes the form of many small models of sub-phenomena that are assembled to create an overall equation. The second approach employs genetic programming to first induce a set of hypothetical relationships that are subsequently selected and improved by a scientist. The paper aims to show that the latter process can produce expressions that are in no way inferior to those produced through the former, and in this case they are significantly better, due to both an improved fit and an economy in the amount of detail that is modelled.

The results are an example of human competitive performance of a genetic programming. However, this is not the whole story: the combination of inductive hypothesis generation by genetic programming and subsequent analysis and modifications by a scientist can significantly improve both the understanding and the modelling of the phenomenon that is researched. This paper presented use of genetic programming as a hypothesis generator for use in scientific discovery. The equation developed with the aid of genetic programming and modified using theoretical considerations is currently the most accurate and elegant formulation of resistance induced by submerged vegetation.