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Informational Entropy and Bridge Scour Estimation under Complex Hydraulic Scenarios

Alonso Pizarro (1), Oscar Link (2), Mauro Fiorentino (1), Caterina Samela (1), and Salvatore Manfreda (1)

(1) University of Basilicata, 85100 Potenza, Italy (alonso.pizarro@unibas.it), (2) University of Concepción, 4030000 Concepción, Chile.

Bridges are important for society because they allow social, cultural and economic connectivity. Flood events can compromise the safety of bridge piers up to the complete collapse. The Bridge Scour phenomena has been described by empirical formulae deduced from hydraulic laboratory experiments. The range of applicability of such models is restricted by the specific hydraulic conditions or flume geometry used for their derivation (e.g., water depth, mean flow velocity, pier diameter and sediment properties).

We seek to identify a general formulation able to capture the main dynamic of the process in order to cover a wide range of hydraulic and geometric configuration, allowing to extend our analysis in different contexts. Therefore, exploiting the Principle of Maximum Entropy (POME) and applying it on the recently proposed dimensionless Effective flow work, W*, we derived a simple model characterized by only one parameter. The proposed Bridge Scour Entropic (BRISENT) model shows good performances under complex hydraulic conditions as well as under steady-state flow. Moreover, the model was able to capture the evolution of scour in several hydraulic configurations even if the model contains only one parameter. Furthermore, results show that the model parameter is controlled by the geometric configurations of the experiment. This offers a possible strategy to obtain a priori model parameter calibration.

The BRISENT model represents a good candidate for estimating the time-dependent scour depth under complex hydraulic scenarios. The authors are keen to apply this idea for describing the scour behavior during a real flood event.

Keywords: Informational entropy, Sediment transport, Bridge pier scour, Effective flow work.