Closure to "Application of AI Approaches to Estimate Discharge Coefficient of Novel Kind of Sharp-Crested V-Notch Weirs"

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This closure provides a response to the discussion of "Application of AI Approaches to Estimate Discharge Coefficient of Novel Kind of Sharp-Crested V-Notch Weirs" by Amin Gharehbaghi and Redvan Ghasemlounia. https://doi.org/10.1061/(ASCE)IR.1943-4774.0001646.

In this paper, based on Figs. 1 and 2, it is clear that the structure of sharp-crested V-notch weir (SCVW) is unique in comparison with the devices described in articles cited in the first discussers' literature review, particularly sawtooth weir. In fact, the SCVW in the general form is the same as the sawtooth weir but with a different number of triangular segments. The applied weirs described in the references provided by the discusser differ absolutely from the SCVW.

The writers' reason for developing a third-order polynomial equation for curves fitting is that a high correlation between discharge coefficients and h/P_1 was required for all the weirs, particularly the sharp-crested triangular plan form weirs, as recommended by Kumar et al. (2011) and Saadatnejadgharahassanlou et al. (2017). Accordingly, applying a third-order polynomial was inspired from the computational trends of Kumar et al. (2011) in Sections "Analysis of data" and "Discharge equation for triangular planform weir."

Because four methods for evaluating C_{dSCVW} were employed in this work [including experimental, gene expression programming (GEP), support vector regression (SVR), and support vector regression–ant colony optimization (SVR-ACO)] for comparison and better presentation of these models' performance, several statistical metrics should be used. Moreover, because defining these artificial intelligence (AI) terms was not in the scope of this journal, the sufficient references were presented in the text for interested readers. Also, explaining all technical terms one by one causes the journal's word count limits to be exceeded.

In this work, Eq. (14) generated by GEP model can be employed only for the initial estimation of C_{dSCVW}. Thus, dependent on the chief editor's decision, we recommend the removal Eq. (14) because it was too intricate. Instead of Eq. (14), the head-discharge relationship of SCVW was developed for two different conditions. With regards to Fig. 2, the following equations at the transition between $h \le P_2$ and $h > P_2$ are suggested as the head-discharge relationship of SCVW

$$\text{for } h \le P_2\colon Q = N_{ts}\left(C_{\mathrm{dSCVW}}\frac{8}{15}\tan\frac{\theta}{2}\sqrt{2g}\right)h^{5/2} \tag{1}$$

$$\text{and for } h > P_2\colon Q = N_{ts}\left(C_{\mathrm{dSCVW}}\frac{8}{15}\tan\frac{\theta}{2}\sqrt{2g}\right) \times (h^{5/2} - (h - P_2)^{5/2}) \tag{2}$$

where Q = discharge; N_{ts} = number of V-shaped weir openings; θ = included angle of each V-shaped opening; g = acceleration due to gravity; P_2 = depth of the V-shaped openings; and C_{dSCVW} = discharge coefficient, which varies with h.

Because in this paper 196 experimental observations have been used for the modeling process, the phrase "nonparametric AI approach" should not be used for SVR, GEP, and hybrid SVR-ACO models and is not the correct choice for this kind of data used as the recommendation of Lary et al. (2016).

The writers' reason for the selection of radial basis function (RBF) kernel function for hybrid SVR-ACO model was explained in the "Validation of the SVR Model" section. Based on Table 5, owing to the higher values of R^2 and AI along with the lower values of root-mean square error, mean absolute error, mean bias error (MBE), and scatter index in the SVR-RBF model compared to SVR-polynomial model, it was concluded that SVR-RBF model has outperformed the SVR-polynomial model. So, RBF was preferred as the suitable kernel function in developing SVR-ACO model.

The motive of the behind choosing the conventional vertex angle was fully discussed in the "Introduction." In this study C_{dSCVW} was investigated in the most popular θ (i.e., 30°, 45°, 60°, 90°, 120°, 128°, and 150°), in the steady, aerated, and free overflow conditions for large physical models in an open channel. The values employed for θ were concluded from previous experimental studies conducted by Kumar et al. (2011) and Saadatnejadgharahassanlou et al. (2017), respectively. Assessing other θ was not in the scope of this research. Moreover, due to time and financial limitations in the hydraulic lab, testing different probable θ was not possible.

The purpose of using multiple statistical matrices in this research is that based on Table 9, it can be inferred the statistical indices are not able to expressly justify the differences among the accuracy and ability of developed AI approaches. The model grading process that can more clarify and precisely assess these differences was employed by considering concurrently the role of all statistical indices utilized. Moreover, the positive and negative values of MBE show that the developed models overestimated and underestimated, respectively, the corresponding observed target.

References

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