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A comparison of entropy methods for estimation of stage-discharge relation in compound channel

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Stage-discharge relation has a wide range of application in various scientific fields that includes channel hydraulics, river hydrology, river sediment discharge and etc. Floods are natural disasters that cause serious damages to properties in their vicinity thus working on flood mitigation strategies can greatly reduce the damage. but, to do so an accurate determination of stage-discharge relationship is required prior to any flood control projects. Therefore, a tremendous amount of time is required to obtain observational discharge data at various stages that can be excruciating. Numerous theoretical methods have been proposed to develop a stage–discharge relation or rating curve including hydraulic, graphical, artificial intelligence, and statistical methods. The stage–discharge relation can be used for prediction of discharge in both natural rivers and channels. In this study, the objective is to compare the rating curve based on Tsallis entropy and Chiu's entropy in a compound asymmetric channel. To this end, laboratory data collected at the Ferdowsi University of Mashhad has been used.
Tsallis entropy describes the generalized form of the Shannon entropy and has been previously used by Singh et al. (2014) to predict the stage-discharge relationship in natural rivers. In their method, parameters of rating curves can be determined from the Lagrange multipliers by maximizing the Tsallis entropy and the Lagrange multiples are calculated using the maximum, minimum and average discharge values.
An alternative method is proposed on basis of velocity distribution introduced by Chiu (1987). The Velocity distribution is obtained from the Shannon entropy and the principle of maximum entropy. His results indicated that the correlation between the mean and maximum velocity was determined by the entropy parameter (M) and that the parameter M for a particular section is always a constant value. In this research, M value was obtained by collecting velocity data and discharge was estimated in distinct stages. Then the amount of discharge is estimated for different values of M and a regression equation is proposed for stage-discharge relation. The validation results from both methods indicate that the rating curve based on Chiu's method is more accurate than Tsallis entropy.