A Conceptual Framework for the Use of Machine Learning for the Synthesis of Stream Discharge – Gage Height Rating Curves

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Abstract. The objective of this research is to use machine learning for the synthesis of stream discharge – gage height rating curves from easily measurable hydrogeologic parameters. A machine learning algorithm would require as input a compilation of relevant hydrogeologic parameters for each gaging station. Since such a compilation does not yet exist, the first step has been to create a conceptual framework that identifies the relevant hydrogeologic parameters that would need to be compiled. Frequent reverse flow or flood waves preclude the existence of a rating curve (unique relationship between gage height and discharge). If a rating curve exists, then a stable channel has a power-law rating curve. Deviations from the power-law curve result from deposition (power-starvation) or scouring (sediment-starvation), which could occur at the high or low range of discharge or both. The eight types of deviation (including no deviation) from the power-law curve can be regarded as eight functional forms of rating curves, which can be represented as lines, parabolas or cubic polynomials on plots of the Z-scores of the logarithms of gage height and discharge. Rating curves can be classified into the eight types based on the hydrogeologic criteria of (1) stream slope (2) relative erodibility of the stream banks (3) distance to the nearest upstream and downstream confluences with relatively significant discharge. USGS gaging stations in Utah were chosen randomly until each of the eight types of rating curves was found. The first example of each type was shown to be consistent with the corresponding hydrogeologic criteria.