LOGARITHMIC MATCHING AND ITS APPLICATIONS IN DATA ANALYSIS

Junke Guo, Assistant Professor, University of Nebraska, Omaha, Nebraska
e-mail: junkeguo@mail.unomaha.edu

Abstract: Hydrological modeling is often based on observational data that often result in nonlinear relationships between variables. For example, the Manning equation is a typical power law; a stage-discharge relationship is often described with one or more power laws; turbulent velocity profile is described with one or more logarithmic or power laws; downstream hydraulic geometries are expressed with one or more power laws; and so on. Recently, Guo (2002) proposed a logarithmic matching that can be applied to analyze nonlinear data sets. It states that for a complicated nonlinear problem or an experimental curve, if one can find two asymptotes, in extreme cases, which can be expressed as logarithmic laws, power laws, exponential laws, or even linear laws, then the logarithmic matching can merge the two asymptotes into a single composite solution. The applications of the logarithmic matching have been successfully tried in several cases in open-channel flows, coastal hydrodynamics and sediment transport such as: 1) the inverse problem of Manning equation in rectangular open-channels, 2) the connection of different laws in computational hydraulics, 3) the solution of wave dispersion equation, 4) criterion of wave breaking, 5) wave-current turbulent model, 6) sediment settling velocity, 7) velocity profiles of sediment-laden flows, and 8) sediment transport capacity. All these applications agree very well with numerical solutions or experimental data. Although the examples are all for hydraulics and sediment transport, the method can be applied to many other nonlinear analyses.