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Genetic Programming for Automatic Hydrological Modelling

Jayashree Chadalawada (1) and Vladan Babovic (2)

(1) National University of Singapore, Singapore (jayashree@u.nus.edu), (2) National University of Singapore, Singapore (vladan@nus.edu.sg)

One of the recent challenges for the hydrologic research community is the need for the development of coupled systems that involves the integration of hydrologic, atmospheric and socio-economic relationships. This poses a requirement for novel modelling frameworks that can accurately represent complex systems, given, the limited understanding of underlying processes, increasing volume of data and high levels of uncertainity. Each of the existing hydrological models vary in terms of conceptualization and process representation and is the best suited to capture the environmental dynamics of a particular hydrological system. Data driven approaches can be used in the integration of alternative process hypotheses in order to achieve a unified theory at catchment scale. The key steps in the implementation of integrated modelling framework that is influenced by prior understanding and data, include, choice of the technique for the induction of knowledge from data, identification of alternative structural hypotheses, definition of rules, constraints for meaningful, intelligent combination of model component hypotheses and definition of evaluation metrics.
This study aims at defining a Genetic Programming based modelling framework that test different conceptual model constructs based on wide range of objective functions and evolves accurate and parsimonious models that capture dominant hydrological processes at catchment scale. In this paper, GP initializes the evolutionary process using the modelling decisions inspired from the Superflex framework [Fenicia et al., 2011] and automatically combines them into model structures that are scrutinized against observed data using statistical, hydrological and flow duration curve based performance metrics. The collaboration between data driven and physical, conceptual modelling paradigms improves the ability to model and manage hydrologic systems.

Fenicia, F., D. Kavetski, and H. H. Savenije (2011), Elements of a flexible approach for conceptual hydrological modeling: 1. Motivation and theoretical development, Water Resources Research, 47(11).