E-14

Spatial Interpolation of Runoff between Catchment Observation Stations using Local Linear Models

○Paul James Smith・関井　勝善・小尻　利治

1. Overview

A system capable of providing short-term runoff forecasts for all locations across a target watershed is introduced. Current runoff forecasting technology is generally capable of producing accurate short-term forecasts at only those locations in a watershed where runoff monitoring stations provide observation data, which is necessary for model parameter fitting, application of real-time error correction schemes, or for the development of data-driven forecasting models. An interpolation method based on a database of distributed hydrological simulation results and using a local linear model (LLM) scheme is introduced to extend this ability to allow flood forecasts to be made for all locations in a watershed, not just those locations where runoff observations are available.

2. Methodology

The distributed flood prediction approach proposed here involves the following steps:

i) Off-line preparation of a database containing results from distributed hydrological simulations for the target watershed.
ii) Prediction of future runoff rates several hours ahead at watershed locations that contain runoff observation stations. The system is designed to be compatible with a variety of different point-prediction techniques including physically-based and data-driven strategies.
iii) Interpolation and extrapolation of these forecasts across the watershed based on knowledge of spatial and temporal relationships between the hydrographs at each watershed location, determined with the aid of the simulation database and the LLM scheme.

3. Database design

A relational database contains precipitation-driven watershed simulation results such as the discharge rate at each watershed location generated at hourly time steps during various runoff simulations.

4. Interpolation strategy

LLM is used here to construct appropriate parametric functions to estimate the relationship of runoff states at all points within a watershed, based on observed or predicted runoff states at observation station locations. As LLM is a local modeling scheme, it searches for similar simulation results (nearest neighbors) from the database, in order to provide real-time tailor made functions to describe the relationship between runoff at different locations to match currently observed conditions.

Unlike global models such as the Artificial Neural Network, an LLM-based strategy is easy to deploy as it requires no tedious off-line training, is easy to understand, and runs from a flexible database which can be automatically updated as new observation data becomes available. Additionally, the format of the query vector can be easily modified as required.

5. Application

An example application of the interpolation strategy is given for typhoon events that occurred in the vicinity of the Nagara River watershed, located in Gifu, Japan.