

Optimization of a Neural Network Model Using a Genetic Algorithm: Predicting Salinity Intrusion in the San Francisco Bay Estuary

T. Rajkumar

SAIC, NASA Ames Research Center, M.S. 269-1, Moffett Field, California 94035

David E. Thompson

NASA Ames Research Center, M.S. 269-1, Moffett Field, California 94035

The atmosphere, the watershed and the coastal ocean all contain a rich spectrum of spatial and temporal structure, much of which is incorporated into the variability of the San Francisco Bay/Delta. The amount of water accumulated in the Sierra Nevada is the major contributor to the fresh water feeding to the Bay/Delta. Like all estuaries, the S.F. Bay/Delta is linked to the coastal ocean and to the inland rivers, resulting in high variability at many scales. Also the estuary has undergone extensive human development over the past 150 years, as has its upstream watershed. In particular long-term changes in estuarine conditions provides a more complete picture of the estuary and its ever-changing climatic context. To understand the complex interactions between climatic conditions, hydrologic changes, and tidal effects, over the long term, requires substantial amount of computer models in various fields. We addressed this complex model using a neural network using Levenberg-Marquardt learning algorithm. We used a genetic algorithm to optimize the minimum number of training data set as well number of hidden neurons to provide faster convergence. The inputs for neural network range from precipitation, snowfall, flow and salinity data collected from monitoring instruments in and around the Bay/Delta. The USGS has established a network of flow monitoring stations in the Delta. Using flow monitoring data from Rio Vista, Three Mile Slough, Jersey Point, and Dutch Slough, a direct estimate of Net Delta Outflow (NDO) is computed. NDO is an arithmetic summation of river inflows, precipitation, agricultural consumptive demand, and project exports. NDO characterizes the upstream watershed. Apart from hydrodynamic data, the stations collect physical and water quality data on a continuous basis monitored one meter below the surface. The parameters provided from the monitoring stations are water temperature, potential hydrogen, dissolved oxygen, air temperature, electrical conductivity [hence, salinity], wind speed, wind direction, solar radiation intensity, and chlorophyll. The GA optimized neural network is trained to understand hydrodynamics, runoff and water quality of the Bay/Delta. This hybrid model is a good predictor for any variable in the Bay/Delta and it helps to understand the complexity very rapidly.