Gene Expression Programming: An Electrical-load Forecast Tool

Atoossa Bakhshaii & Roland Stull
abakhsha@eos.ubc.ca

a place of mind
The University of British Columbia
Department of Earth and Ocean Science

BC hydro
Natural Sciences and Engineering Research Council of Canada
Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA)

Objective

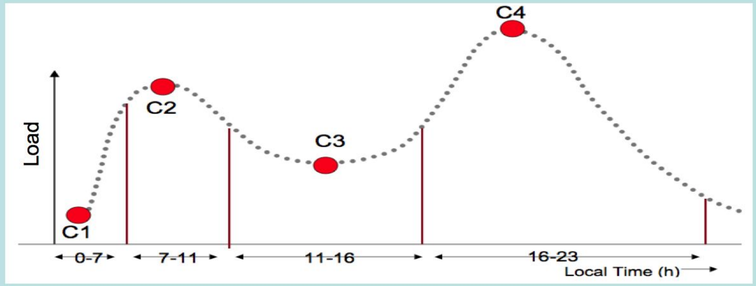
Electric utility companies plan ahead to match supply with demand, to prevent shortfalls and surpluses of energy. One factor that strongly influences electricity demand is weather. Electrical consumption (known as load) is sensitive to air temperature, humidity, cloudiness, precipitation, wind, and also depends on time and day of the week. Gene Expression Programming (GEP) has been used to estimate electrical load via a nonlinear combination of weather, calendar and load past-data. From a population of competing and evolving algorithms, GEP uses a computational version of natural selection to find the algorithm that maximizes a verification fitness function for electrical load.

Acknowledgments. Thanks to Heiki Walk and Doug McCollor of BCHydro for providing electrical load data and guidance. George Hicks supplied weather data and Henryk Modzelewski provided incredible programming aid.

91st AMS Annual Meeting
January 20111

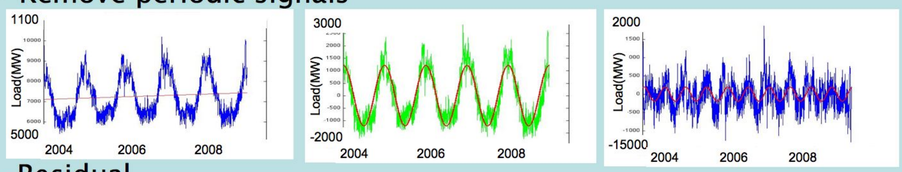
Model Innovation

1. Focus on prediction of 4 key load points

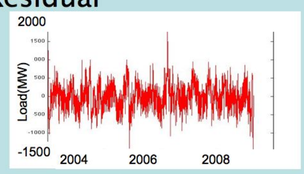


2. Split problem

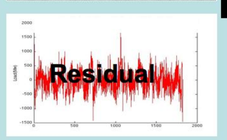
–Remove periodic signals



–Residual

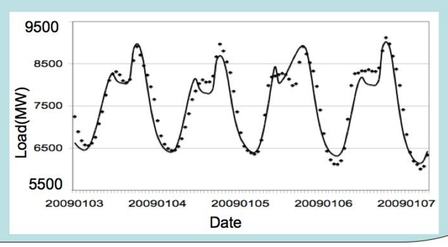


3. Use GEP to find the best model to predict residual

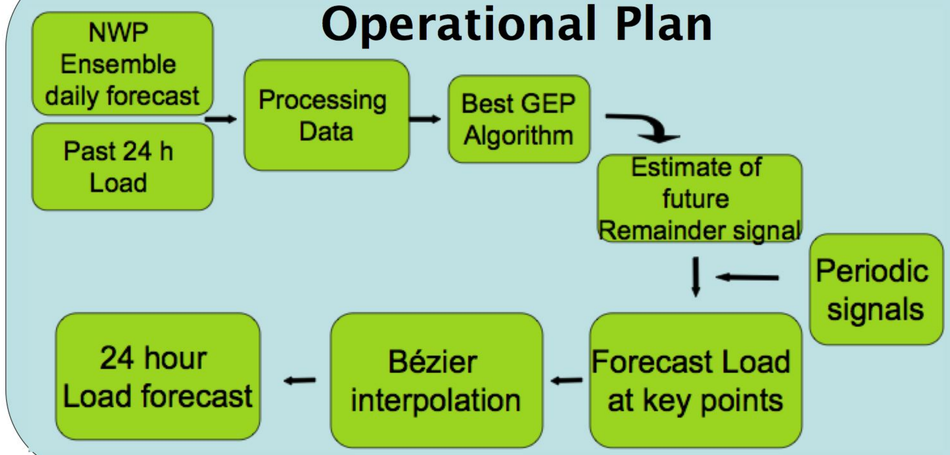


Find The Best Algorithm (unique algorithm developed for 4 key points)

4. Interpolate in time between points using Bézier curve

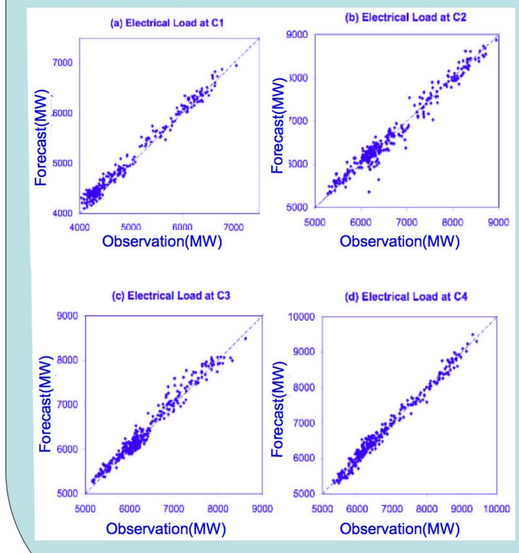


Operational Plan

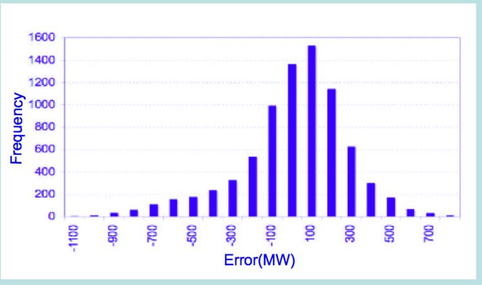


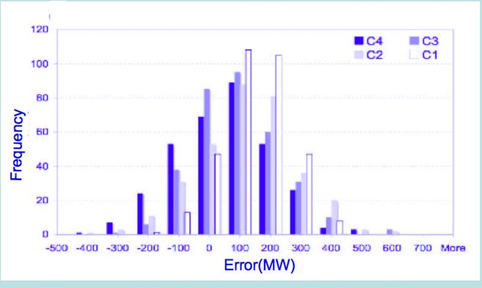
Results

Forecast of total electrical load in BC vs. observation for each key load point for the independent scoring data set (2009). Corresponding values of r^2 are (a) 0.98, (b) 0.97, (c) 0.97, and (d) 0.98.



Error distribution for the hourly load forecasts.





The error distribution for each key point from forecasts that include updating past loads with their observations.