WATER SENSOR TIME SERIES VALIDATION USING A PARITY SPACE METHOD

Peter Hudson – Head, Product Innovation **
Touraj Farahmand – Head, Product Development
Edward Quilty – President and CEO

Keywords: Water Quality, Time Series, Validation, Parity Space, Quality Assurance,

In recent decades, automated water quality and quantity monitoring has grown increasingly common in the study and assessment of both natural and controlled water systems. However, sensor and maintenance problems, in conjunction with radio telemetry transmission faults, can lead to erroneous measurements, and real-time identification of errors in voluminous high-frequency data can be both challenging and highly inefficient. False positives due to sensor errors add considerable costs to the operation of a water distribution system. Conversely lack of timely identification of changes in system conditions can have even more serious consequences.

The problem of sensor validation has been extensively studied in the fields of chemical plant, aerospace, and nuclear power engineering. We adapt the parity space method, proposed in these fields, to the problem of water sensor data validation; by adjusting the phase between distant sensor to account for water travel time, and the automated use of regression modeling to remove offset and system response magnification or attenuation. Since direct physical redundancy of sensors is seldom available in water distribution systems we adapt the parity space residual method by using a gamma distribution of the parity vector magnitudes to assign point-by-point data validation flags (Red, Orange Yellow, and Green); thereby providing a visual indicator of data reliability in real time to system operators.

This specific application of the parity space technique requires the assumption that the redundant time series are of high quality, although the method is robust to deviations in a minority of redundant signals, and capture enough of the processes controlling the dynamics of the target series. If that assumption is not met, the parity space method becomes a more general method of congruency analysis. It can thus be extended to assess a target time series for a broader set of anomaly classes, such as event detection.

Several examples are presented.