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Model for location and failure alarms by ruptures on intelligents water supply systens

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Abstract
The urban water supply is a huge problem faced in the modern world, once that it is frequently affected by leaks that leads to the waste of large amounts of water, time and money, three of the main pillars for the sustainable development of the cities nowadays. A quick detection of anomalous events such as leaks can bring significant gains to the companies. Such detection allows faster repairs of failures, ensuring a better attendance of the clients and smaller costs involving waste of water. Considering the needs of the development of an alarm system that acts readily when the system is under an anomalous event, this study aims to use computational tools of data analysis through neural networks for water demand predictions, and starting from the errors obtained from the comparison between the results of the predicted and the monitored data, detect the presence or not of anomalous events.

Key words:
Smart cities, model for failures detection, model for demand prediction, recurrent networks, NARX.

.Introduction

With the increase of the number of big cities in the world, the need for solutions to the modern age, like the full attendance of the citizens under scarcity of resources, gets bigger each time. Among the most important urban services for the good development of the cities, the water supply has a huge importance due to its fundamental role for the healthiness and safety. Due to the importance of that service, the problems related to it are bigger as the bigger is the population.

The use of artificial neural networks has been widely found on the literature, with highlights in the application to water resources for determination of long time variables or for the estimation of states in short intervals.

Considering the importance of the fast identification of anomalous events in the water supply systems, this work aims the development and utilization of a computational neural network (NARX) for analyzing data and predicting water demand in cities, and starting from the predicted and measured on field analysis, generate alarms that shows the presence of non-wanted events.

Results and Discussion

With the development of the neural networks on MatLab platform, water demand data of Santa Bárbara city were inserted, such as data related to social behavior (time of the day, day of the week) and climate data (temperature, humidity). The climate data were obtained from the National institute of meteorology with measures taken in the interval of an hour. For a better precision of the neural network, a linear interpolation was made so the data would be in an interval of fifteen minutes, matching with the interval from the demand data. After that, the defective data were eliminated (data with negative demand, for example), so that a more trustworthy database could be built. In a set of approximately six months of data, three months were used to train the network and the rest to validate it.

The performance of the neural network of predicting the demand was quite satisfactory. Making an analysis of errors between the predicted demand and the real one, it was proved the effectiveness of the neural network (NARX), since the measure of the errors was 0,1864L/s.

The application of the neural network for the continuous series of measures of the sector under study allowed us to analyze the mistakes made by the neural network and with that, identify anomalous events that correspond exactly to the spots where the neural network is not trained to work, generating big errors.

Conclusions

The anomalous events in water supply systems should be quickly detected, so that the economic and security consequences are readily mitigated.

From the methodology proposed in this work, it was concluded that the tool of neural networks used was effective in its purpose of predicting water demand based in real demand. Such effectiveness was proved by the error analysis, which the average was 0,18L/s.

The detection of anomalous events starting from error analysis requires a deepening of the statistics tools of series control so the events can be detected with a bigger precision. The study must be continued in a bigger scale and with a new demand database, besides an effective study using pressure data, so the detection of the anomalies is more effective, since finding its location will get easier and the waste of water much smaller.

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- B. M. Brentan, E. Campbell, G. Lima, D. Manzi, D. Ayala-Cabrera, M. Herrera, I. Montalvo, J. Izquierdo, E. Luvisotto Jr., **2016**, On-Line Cyber Attack Detection in Water Networks through State Forecasting and Control by Pattern Recognition.
- Broad, D. R., Dandy, G. C., Maier, H. R., & Nixon, J. B. (2006, July). Improving metamodel-based optimization of water distribution systems with local search. In 2006 IEEE International Conference on Evolutionary Computation (pp. 710-717). IEEE.