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SOFT COMPUTING FOR SMARTER OPERATION MANAGEMENT IN WATER DISTRIBUTION SYSTEMS

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ABSTRACT

The complexity of water distribution systems (WDSs) derives from the nature of the classical hydraulic models describing WDS phenomena [1], and from the increased need to suitably handle the huge amount of data generated in the various processes associated with water distribution (see, for example, [2-6]). WDSs must be: firstly, suitably designed (in the case of new systems) and refurbished (enlarged and rehabilitated at later stages) so that they can provide the intended service; secondly, suitably monitored to have enough quality judgement elements for (preferably real-time) control; thirdly, optimally operated to provide seamless quality service; and finally, properly managed to integrate the maximum number of benefits, including conflicting objectives such as economic revenue and social satisfaction.

Given the complexity of the problems associated with WDSs, efficient numerical techniques are needed. For example, robust and efficient optimisation algorithms (able to deal with non-linearities, mixed variables, and discrete processes – including those with an evolutionary vocation) are paramount in design and refurbishment tasks. The monitoring of service quality, especially real-time, will benefit from efficient techniques of time series data treatment, including a number of mathematical transforms. Operation may be defined in terms of a number of Boolean operators optimally defined and integrated into appropriate data structures (relying, in turn, on other types of optimisation techniques). Finally, management includes a

wide spectrum of issues: demand forecast; network sectorisation; leakage detection; cadastre maintenance; and consumer satisfaction assessment, among others.

The soft computing techniques used to approach these processes (such as neural networks, support vector machines, clustering, agent-based systems, and social network theory) are expected to be robust and efficient. In addition, despite some of the elements integrated in these issues being quantifiable, others may be classified as intangible. As a consequence, suitable techniques to treat information that is plagued with uncertainty and subjectivity are also needed.

Further research is essential to develop algorithms that apply in real-world situations and on datasets with many elements. In particular, in the water distribution industry, improvements in big data computing for exploiting data as fully as possible in Advanced Metering Infrastructures (AMI) will greatly help reduce non-revenue water in the near-term. Moreover, such improvements will contribute, through more efficient operation, to maintaining a level of long-term excellence in the urban water cycle and, eventually, contribute to the smart city concept.

In this session, contributions are sought that address computational techniques easing the application of the abovementioned procedures in the water distribution field.

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