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LAYERED MACHINE LEARNING FOR SHORT-TERM WATER DEMAND FORECASTING

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Abstract

Water Distribution Networks (WDN) are large-scale systems whose management is a complex task, with increasing environmental and socio-economic implications worldwide, and with a renewed considerable attention by all stakeholders: local authorities, regulators, environmental groups and the scientific community.
WDM managers need to reliably estimate the water demand in the short-term (typically 1 day ahead), in order to operate their reservoirs and treatment plants appropriately to meet demand while reducing costs, in particular energy-related costs for caption, treatment and pumping.
In this paper the authors propose a fully adaptive, data-driven and self-learning approach to forecast short term urban water demand in two stages: *i)* identifying and characterizing typical daily consumption patterns (based, at least, on hourly demand data) and *ii)* dynamically generating a set of forecasting models for each typical pattern identified at the previous stage. This schema permits to deal with nonlinear variability of the water demand at different levels, automatically characterizing periodicity (e.g., seasonality) and behaviour-related differences among different types of days and hour of the day.
The approach has been validated on the urban water demand data acquired through the SCADA system of the Metropolitana Milanese (MM) partner, the urban water distribution utility in Milan, Italy.
Moreover, the approach has been developed in order to work also at individual (customer) level, exploiting the new available technological solutions for smart metering (i.e., Automatic Metering Readers, AMRs) now being installed in MM.

Keywords: Short-term water demand forecasting, Support Vector Machines regression, time-series clustering

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