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Building an open high-resolution residential water end-use dataset with non-intrusive metering, intrusive metering, and water use diaries

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Accurately estimating how residential water consumers use water among different component end uses can help managers better understand consumer behaviors and identify appliances and customized conservation programs to enable efficient water uses with minimal efforts and costs. Since the late 1990s, the development of several intelligent water meters created new opportunities to record water use with high, sub-minute, temporal frequency and spatial scale. Yet, many challenges still prevent accurate measurements or estimates of water end uses. On the one hand, installing one meter for each end use is costly and intrusive, thus not economically convenient and not socially acceptable. On the other hand, unpacking end uses from aggregate water use time series recorded via single-point sensors installed at the inlet of each household requires accurate end-use disaggregation algorithms. Most of the state-of-the-art water end-use disaggregation algorithms still need an intrusive calibration phase or time consuming expert manual processing, and algorithm development and benchmarking is often limited by the unavailability of open, high-resolution, water end-use datasets.
In this work, we build an open, high-resolution, water end-use dataset adopting a double approach. First, we record a dataset by coupling a commercial single-point meter able to sense water consumption at a sub-minute resolution for a single apartment with water use diaries compiled by the water users. In this phase, we chose a non-intrusive, portable, professional, ultrasonic sensor. Second, we calibrate a few small mechanical flow meters, adapt them for direct installation on each end use, couple them with a data logging system, and record a second end-use dataset. Given the adopted technology, this second approach has lower cost than the first one, but it is intrusive and meters are not easily portable. We finally compare the two approaches in terms of costs, feasibility, and measurement accuracy and report preliminary results on automatic end-use disaggregation for both cases. This research delivers the first open high-resolution residential water end-use dataset with ground truth end-use time series and serves as a baseline for the development and benchmarking of water end-use disaggregation algorithms, as well as starting point for future contributions of open water data from smart meters.