A preliminary low-frequency pressure analysis towards high-frequency transients monitoring in the Padua water distribution system

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Abstract The water distribution system (WDS) of Padua, Italy, is a complex network of 1,246 km of pipes. In order to control and improve the efficiency of such a system, recently, AcegasApsAmga, the Padua water utility company, started monitoring transients. A preliminary analysis of the available pressure measurements provided by the existing remote-control system has been executed. These measurements, with a time step of 15 minutes, allows pointing out the most critical areas of the WDS, i.e., the ones exposed to the most severe pressure variations.
Keywords: field tests, water distribution system, transients, monitoring.

Methods

Low-frequency pressure measurements, acquired by the manager in the network of Padua (Italy) within the remote-control system (time step 15 min), are used to locate the areas of the network mainly exposed to the most severe pressure variations. Based on this preliminary study, it is possible to make decisions on where to put high-frequency mobile dataloggers to monitor transients in the system.

Figure a) shows the pressure signals acquired on a normal (i.e., with no uncommon maneuvers executed) midweek day (July 15 2020). The behavior is extremely similar, even if the sensors are in very different pipe sections in an area of about 3 x 4 km.

Results

Figure b) shows the histograms analysis of the pressure variations. The most severe pressure variations happen at the following sites: P036, P037, P058, P175, P193.

Specifically, the measurement section P175 is located immediately downstream of the Brentelle pumping station in a steel DN700 pipe. Equivalently, sections P058, P193 (in two steel DN600 pipes), and P037 (in a HDPE DN315 pipe), are located downstream of the Montà pumping station. In addition, the P036 point shows quite large and stable pressure fluctuations, even if it is located in a residential area in a small plastic pipe (HDPE, DN160).

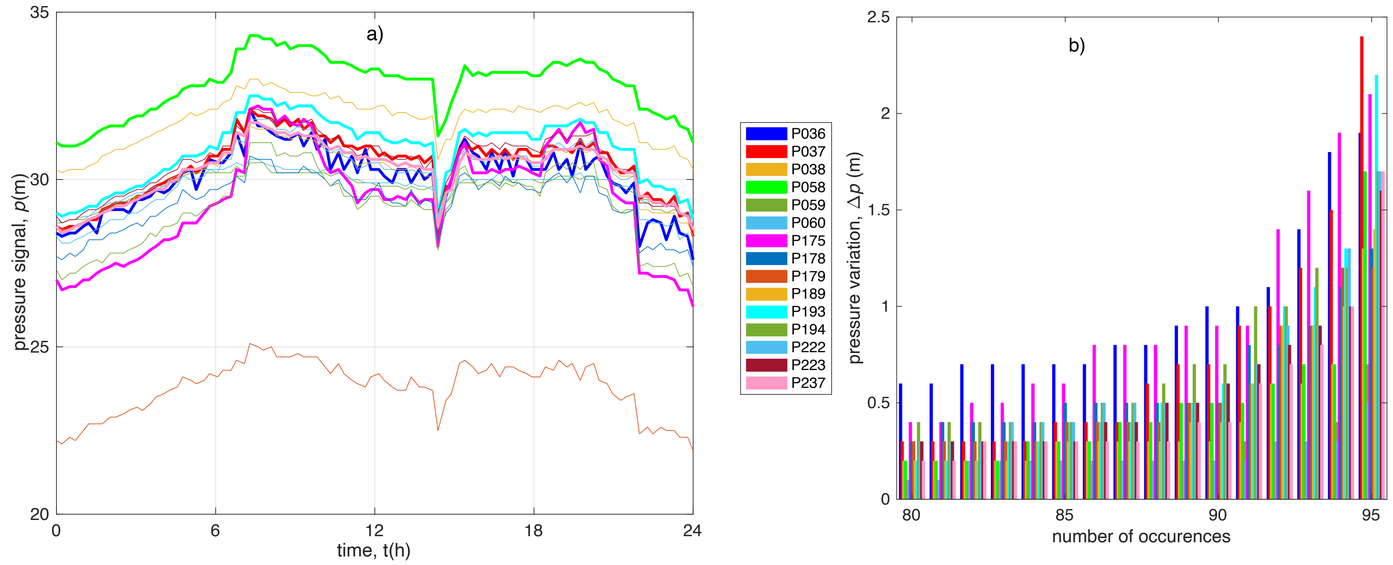

Figure 1: Pressure signals and histograms of head change rates for the permanent measurement sections of the west part of the Padua water distribution system.

Conclusions

- The preliminary analysis of the low-frequency pressure measurements confirms that high-frequency measurements are needed to better understand the transient response of the systems.
- Moreover, such analysis points out in which sites the high-frequency mobile data loggers should be preferably installed.

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