Example networks

Example Networks 1 to 4 are those used in Gorev et al (2019). Example Networks 1 and 2 illustrate cases where EPANET 2 produces incorrect results, and Example Networks 3 and 4 illustrate cases where EPANET 2 fails to converge.

To test the hybrid simulator on networks with multiple valves, in Example Networks 3 and 4 the demands were assumed to be pressure dependent and simulated using the technique of Gorev and Kodzhespirova (2013). In that technique, a pressure-dependent demand q is simulated by adding to the demand node an artificial FCV (AFCV), a fictitious node (FN), an artificial CV pipe (AP) with a minor loss, and an artificial reservoir (AR), whose parameters are such that the familiar Wagner demand relationship, q versus pressure P, is implemented: $q = 0$ if $P \le 0$, $q = q_{req}(P/P_{des})^{1/2}$ if $0 < P < P_{des}$, and $q = q_{req}$ if $P \ge P_{des}$ where $q_{req} =$ required demand and $P_{des} =$ desired nodal pressure at which the required demand should be satisfied. The available demand is determined as the flow in the added artificial string.

The artificial components in Example Networks 3 and 4 are not shown on the network maps. The IDs of the artificial components added to a demand node with ID "N" are "Nv" for the AFCV, "Nn" for the FN, "Np" for the AP, and "Nr" for the AR, For example, the IDs of the artificial components added to demand node 12 will be "12v", "12n", "12p", and "12r" for the AFCV, the FN, the AP, and the AR, respectively. The desired pressure of a demand node (this parameter is absent in EPANET 2) is specified as the value of the initial quality of the FN added to the demand node. This way to specify the desired pressure does not affect the water quality at the real nodes because the water cannot flow from an FN to its real demand node: It can only flow to the AR of that node.

The hybrid simulator treats the demands as pressure-dependent ones using the technique of Gorev and Kodzhespirova (2013) if an least for one demand node with ID "N" there exist two links with IDs "Nv" and "Np" (AFCV and AP) and two nodes with IDs "Nn" and "Nr" (FN and AR). Otherwise, the demands are considered pressure independent as in the original EPANET 2.

N. B. Gorev, V. S. Gorev, I. F. Kodzhespirova, I. A. Shedlovsky, and P. Sivakumar. 2019. "Hybrid simulator for water distribution networks with control valves." *J. Water Resour. Plann. Manage.* 145 (10): 06019009. https://doi.org/10.1061/(ASCE)WR.1943-5452.0001116

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