

SMART OPTIMISATION AND SENSITIVITY ANALYSIS IN WATER DISTRIBUTION SYSTEMS

Philip R. PAGE

Abstract

Parameter uncertainty in water pipe network models are studied using newly developed simplified mathematical notions. These enable studies to be done using public domain software, including EPANET. The results obtained can be easier to use and interpret than those obtained from more general mathematical notions. The general idea is to study how a flow- and pressure-related quantity varies as a set of state parameters are varied. The quantity considered here is the average pressure, enabling smart optimisation of a water distribution system by keeping the average pressure unchanged as water demands change, by changing the speed of the pumps. Another application area considered, using the same mathematical notions, is the study of the sensitivity of parameters. Two models are analysed as examples, showing how smart optimisation works, and what the sensitivity of various sets of parameters are. The various parameter categories have very different sensitivities to a given change in the average pressure that can be tolerated. The critical state parameters to determine accurately in the models depend on the network. For the combined schemes studied as examples, variation of the pressure with reservoir depths is only related to the reservoir depths, and the pressure does not vary with the tank diameters. There is a relationship between variations of the various pipe parameters for both the Hazen-Williams and Chezy-Manning pipe major friction loss formulas. It holds for any network where there are no pipe minor friction losses. Pipe diameters are the most sensitive, pipe roughness coefficients are medium sensitive, and pipe lengths are the least sensitive.