Optimising water distribution systems using a weighted penalty in a genetic algorithm

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Abstract

Genetic algorithms (GAs) have become the preferred water system design optimisation technique for many researchers and practitioners. The main reason for using GAs is their ability to deal with nonlinear complex optimisation problems. The optimal decision in terms of designing, expansion/extending, addition or rehabilitation of water supply systems has to review possible options and select a cost-effective and efficient solution. This paper presents a new approach in determining a penalty value depending on the degree of failure, of the set pressure criteria, and the importance of the link supplying a specific node. Further modifications are also made in the cross-over and mutation procedures to ensure an increase in algorithm convergence. EPANET, a widely used water distribution network simulation model, is used in conjunction with the proposed newly developed GA for the optimisation of water distribution systems. The developed GA procedure has been incorporated in a software package called GANEO, which can be used to design new networks, analyse existing networks and prioritise improvements on existing networks. The developed GA has been tested on several international benchmark problems and has proved to be very efficient and robust. The EPANET hydraulic modelling software as well as the developed GANEO software, which performs the optimisation of the water distribution network, is freeware. The software provides a tool for consulting engineers to optimise the design or rehabilitation of a water distribution network.

Keywords: optimising, water distribution system, genetic algorithm