10th International Congress on Civil Engineering, 5-7 May 2015
University of Tabriz, Tabriz, Iran

NetOD: A GA-Based Decision Support System for Optimization and Uncertainty Analysis of Water Distribution Networks

Mohammad Ali Geranmehr[1], Keyvan Asghari[2]

1- PhD Student, Department of Civil Engineering, Isfahan University of Technology
2- Assistant Professor, Department of Civil Engineering, Isfahan University of Technology

Corresponding Author's E-mail: geranmehr@hotmail.com

Abstract

Water distribution networks (WDNs) are one of the most important and expensive infrastructures in cities. There are no efficient decision-making results when using only economical aspect in WDNs optimization problems. Therefore many researchers try to define indexes and using multi-objective optimization models in order to consider other aspects like reliability. However, most of the methods developed in this field, due to inefficiency or computational complexity, are rarely used in practice by design engineers. In this study, a comprehensive and flexible GA-based Decision Support System (DSS) model for optimization and uncertainty analysis of WDNs has been presented by using GA and EPANET called NetOD. Since the hydraulic failure is more important than mechanical failure, an uncertainty analysis as a post processing step has been used instead of reliability index. The model performance has been investigated by an example witch shows that uncertainty analysis enhances the practical aspects of WDNs design and operation.

Keywords: DSS, WDNs, Genetic Algorithm, Optimization, Uncertainty Analysis.

1. INTRODUCTION

Water distribution networks (WDNs) are some of the most important and critical infrastructures in cities which require mathematical modeling in design and operation stages. High constructional costs on one hand and non-linear nature of the equations along with the large amount of calculations associated with uncertainties in parameters on the other hand, expand its scale and increase the complexity of modeling. Literature generated in the last two decades indicating promising solution to WDNs problems. For example Eusuff, and Lansey [1] used SFLA[1] and Maier et al. [2] used ACO[2] for WDNs optimization. Liong and Atiquzzaman [3] used SCE[3] algorithm which is a population-based algorithms. Kadu et al. [4] proposed a method to decrease the search space in GA[4] for WDNs optimization problems. This method was based on critical method by Behave. The method was very effective but its complexity and non-automatic algorithm reduced its popularity. Reca et al. [5] used GA, SA[5], ILSSA[6] and MSATS[7] algorithms for WDNs optimization. The results showed that GA has better performance. Baños et al. [6] used MA[8] for WDNs optimization and compared the results with SA, GA, MSATS and SSSA[9]. The results showed that MA has a very good performance in this case. Amirabdollahian et al. [7] proposed a new fuzzy genetic algorithm called FGA[10] and successfully used that in a WDN optimization problem. Siew et al. [8] proposed a multi-objective evolutionary optimization approach for the phased whole-life design and rehabilitation of WDNs. The results of two sample networks in the literature showed that the algorithm is stable and found near-optimal reliable and efficient solutions.

[1] Shuffled Frog Leaping Algorithm
[2] Ant Colony Optimization Algorithm
[3] Shuffled Complex Evolution Algorithm
[4] Genetic Algorithm
[5] Simulated Annealing Algorithm
[6] Iterated Local Search with Simulated Annealing
[7] Mixed Simulated Annealing and Tabu Search
[8] Memetic Algorithm
[9] Scatter Search with SA as local searcher
[10] Fuzzy Genetic Algorithm