Optimization of Multiple and Multipurpose Reservoir System Operations by Using Matrix Structure (Case Study: Karun and Dez Reservoir Dams)

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Abstract

Optimal operation of water resources in multiple and multipurpose reservoirs is very complicated. This is because of the number of dams, each dam’s location (Series and parallel), conflict in objectives and the stochastic nature of the inflow of water in the system. In this paper, performance optimization of the system of Karun and Dez reservoir dams have been studied and investigated with the purposes of hydroelectric energy generation and providing water demand in 6 dams. On the Karun River, 5 dams have been built in the series arrangements, and the Dez dam has been built parallel to those 5 dams. One of the main achievements in this research is the implementation of the structure of production of hydroelectric energy as a function of matrix in MATLAB software. The results show that the role of objective function structure for generating hydroelectric energy in weighting method algorithm is more important than water supply. Nonetheless by implementing ε- constraint method algorithm, we can both increase hydroelectric power generation and supply around 85% of agricultural and industrial demands.

Introduction

Large dams are usually built for different purposes such as urban water supply, industrial, agricultural, power generation, flood control, environmental objectives, navigation etc. Recently, much research has been done to achieve certain objectives in optimal reservoir operation; such as optimizing hydroelectric power [1, 2], flood control [3], irrigation [4, 5], and environmental [6–8]. The main research methodologies are about achieving the optimum level of release and optimal storage volume by considering the changes in inflow and needs [9].

In the past few years, researchers used different methods to achieve the mentioned objectives like Linear Programming (LP) or Evolutionary Algorithms (EA) such as Genetic Algorithms (GA). Comprehensive reviews of these techniques have been written several years ago, for instance, Yeh [10], Wurbs [11] and Labadie [12]. However, due to the physical and operational characteristics, a unique algorithm cannot be selected as the best standard technique [10].