Analysis of water distribution system in urban China through system dynamics approach

Longxi LUO, School of Civil Engineering at Tsinghua University, China and Jianping WU, School of Civil Engineering at Tsinghua University, China

WFEO

With rapid urbanization and industrialization, urban China is confronted with growing pressure to provide sufficient and clean water for industrial, agricultural, and domestic usages. However, major metropolises have been struggling to supply water resources since the nineties due to rapid growth. National and local governments have been providing guidance and support for exploring creative ways to reform water distribution and management systems. It is however the burden of engineers and scientists to provide the cutting-edge technologies. In this paper, the water distribution system of a major city Hangzhou is analyzed and optimized through numerical simulation and system dynamics approaches. Hangzhou is located in an economical triangle and has undergone rapid development in the past decades, therefore is a classical representation of metropolises struggling with water supplies. Firstly, the water distribution system is represented by a network simulation model, and properties of the system are studied. The simulation model is built based on the topology of the water distribution system and the pressure-driven modeling theory. Properties such as water pressures, flows and qualities are studied, so problems of the system can be identified. Possible solutions are provided and evaluated in the simulation model. In the network simulation, the engineering design of the water distribution system is studied independently. However, water supply and demand can be affected by many factors. Therefore, secondly, a system dynamics model is constructed for the city to investigate the complex interactions between the water supply/demand ratio and other parameters affecting the system. The most influential factors in the city are identified through sensitivity analysis and optimized to avoid water shortages in the future.