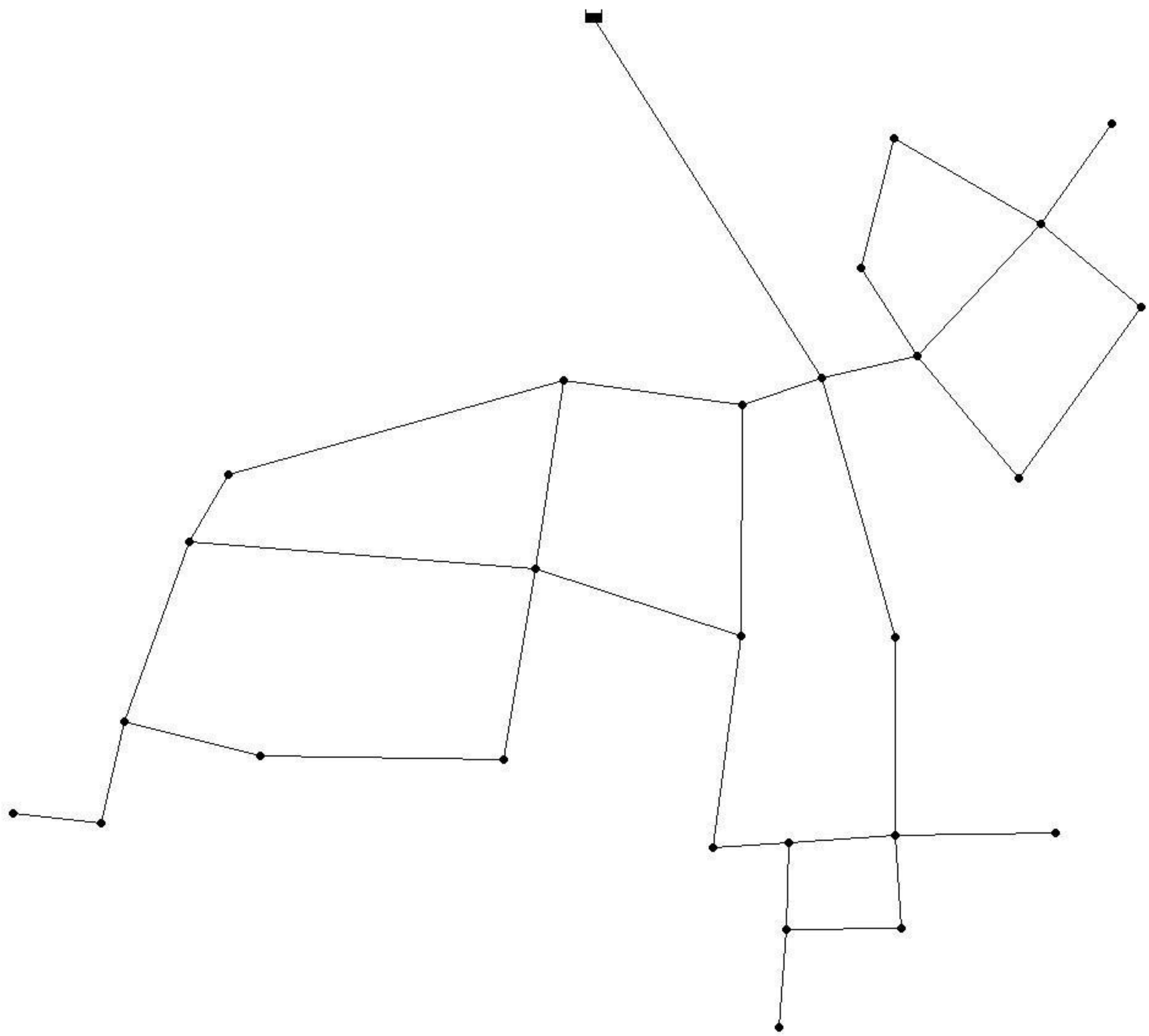
SYSTEM ID: Jilin

NARRATIVE DESCRIPTION

The Jilin system is a synthetic system with an average demand of 112,000 CMD. The network was first presented by Bi & Dandy (2014) in a study of online retrained metamodels. A general schematic of the system is shown below. The system has one reservoir and 29 kilometers of pipe.

NETWORK SCHEMATIC:



HISTORY OF THE NETWORK FILE

The Jilin system was originally developed by Bi & Dandy (2014) as part of a study of optimization via online retrained metamodels. Optimized variables included chlorine dosing and pipe sizes over a 24-hour extended period simulation.

ORIGINAL REFERENCE:

Bi, W. and Dandy, G.C., 2014. Optimization of water distribution systems using online retrained metamodels. *Journal of Water Resources Planning and Management*, *140*(11), p.04014032. https://doi.org/10.1061/(ASCE)WR.1943-5452.0000419.

ABSTRACT: This paper proposes the use of online retrained metamodels for the optimization of water distribution system (WDS) design. In these metamodels, artificial neural networks (ANNs) are used to replace the full hydraulic and water quality simulation models and differential evolution (DE) is utilized to carry out the optimization. The ANNs in the proposed online DE-ANN model are retrained periodically during the optimization in order to improve their approximation to the appropriate portion of the search space. In addition, a local search strategy is used to further polish the final solution obtained by the online DE-ANN model. Three case studies are used to verify the effectiveness of the proposed online retrained DE-ANN model for which both hydraulic and water quality constraints are considered. In order to enable a performance comparison, a model in which a DE is combined with a full hydraulic and water quality simulation model (DE-EPANET2.0) and an offline DE-ANN model (ANNs are trained only once at the beginning of optimization) are established and applied to each case study. The results obtained show that the proposed online retrained DE-ANN model consistently outperforms the offline DE-ANN model for each case study in terms of efficiency and solution quality. Compared with the DE-EPANET 2.0 model, the proposed online DE-ANN model exhibits a substantial improvement in computational efficiency, while still producing reasonably good quality solutions.

ADDITIONAL CITATIONS:

The original publication by Bi & Dandy (2014) and by inference the Jilin system have been cited by 28 additional authors. These may be accessed by moving your cursor over the following link while simultaneously depressing the CTRL key on your keyboard: 28 Citations.

AVAILABLE INFORMATION

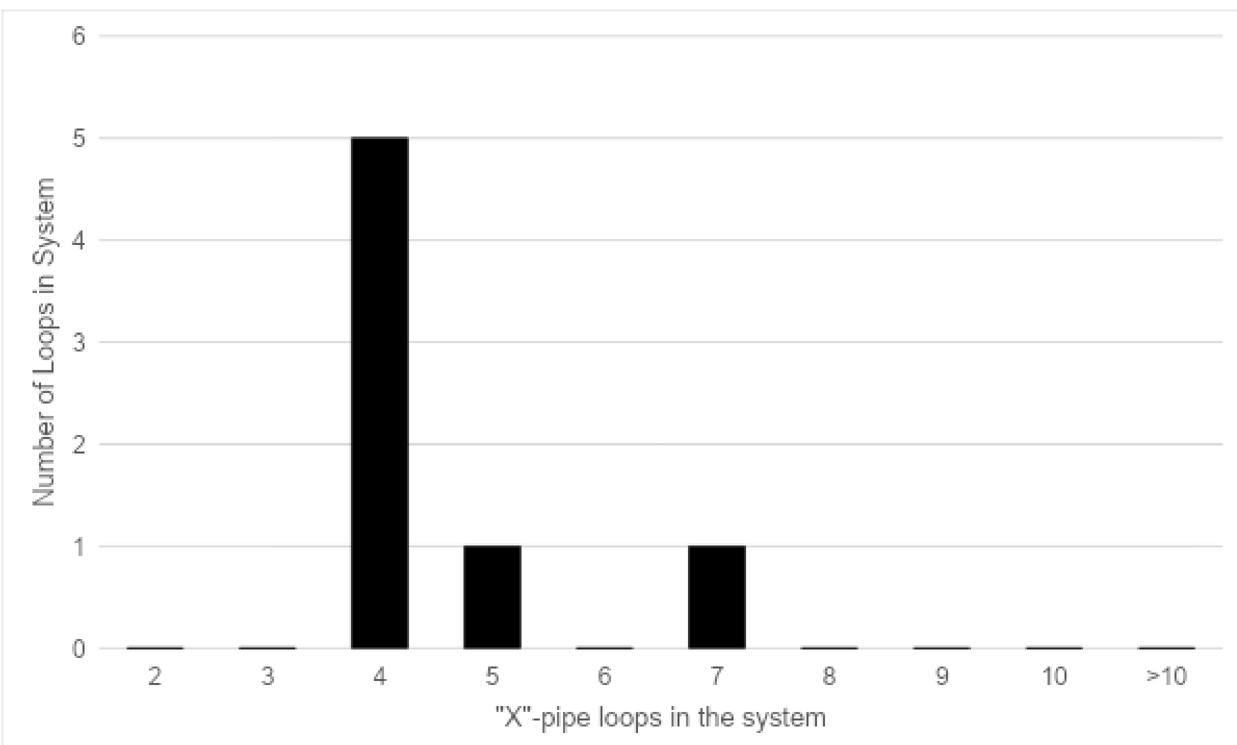
Physical attributes	Yes
Schematic diagram	Yes
Network geometry data	Yes
GIS data file	No
Background map	No
Elevation data	Yes
Pipe data	Yes
Pipe material	No
Pipe age	No
Pipe pressure class	No
Nominal or actual diameters	Nominal
Pump data	NA
Useful horsepower	
Pump operating curves	
Tank data	NA
Elevation data	
Stage storage curves	
Water quality information	
Valve data	NA
PRV/FCV data	
Isolation valve data	
Hydrant data	
Demand data	Yes
Total system demand	No
Nodal demand data	Yes
Temporal data demands	Yes
System leakage	No
Hydraulic data	No
Hydraulically calibrated model	
Field hydraulic calibration data	
Water quality data	Yes
Disinfection method	Yes
Chlorine residual data	No
Booster station data	No
Fluoride/Chloride field data	No
Water quality calibrated model	No
Operational data	No
SCADA datasets	
Operational rules	

<u>SYSTEM CLASSIFICATION:</u>

PIPE/LOOP HISTOGRAM:

Hoagland et al. (2015) designed a network classification algorithm for use in classifying water distribution systems as either “branched,” “looped,” or “gridded” based on the observed frequency of network loops with different numbers of distinct pipe segments. The frequency distribution for the Jilin system is provided below. Using this information, Hoagland et al., classified this system as being a GRIDDED system.

# Total Pipes:	34
# Branch Pipes:	7
Ratio (Branch Pipes / Total Pipes):	0.21



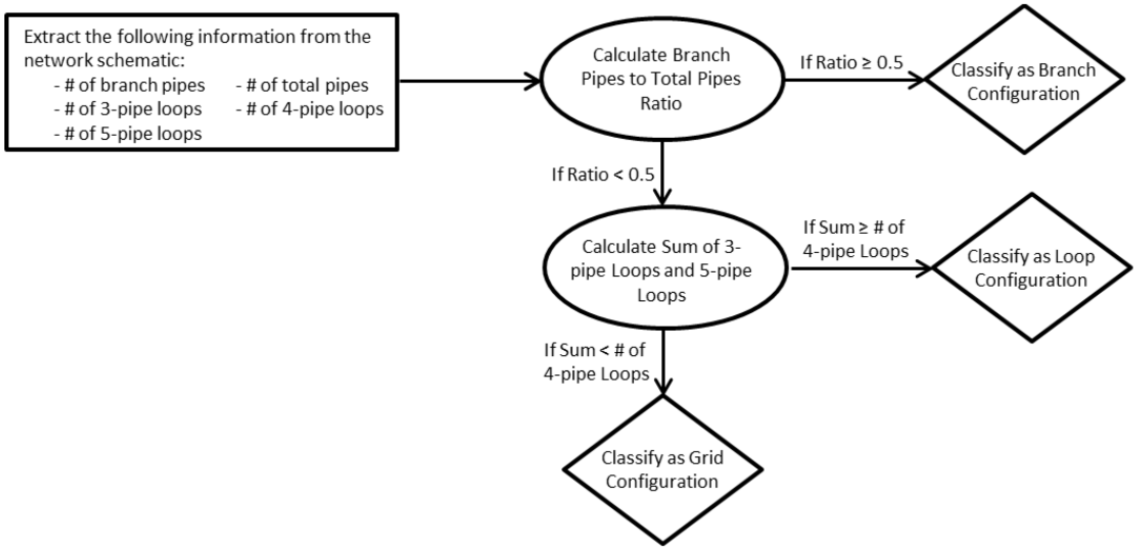


Figure 3.4. Classification Algorithm (Hoagland et al., 2015)

Hoagland, Steven & Schal, Stacey & Ormsbee, Lindell & Bryson, Lindsey. (2015). Classification of Water Distribution Systems for Research Applications. 696-702. 10.1061/9780784479162.064.

NETWORK STRUCTURE METRICS:

Building on the work of Hoagland et al., (2015), Hwang & Lansey (2017) created an expanded classification system that allows for further classification of a system as being either a transmission or distribution branched, looped, gridded, or hybrid system. Their algorithm streamlines the classification system by removing unnecessary nodes that do not contribute to the structure of the system while still retaining their use as intermediate points for demand data entry. A full description of the algorithm can be found in the cited reference.

Application of the Hwang and Lansey classification algorithm to the system yields the following statics and associated classification:

Parameter	Value
Edges	34
Pipes	34
Nodes	28
Average Diameter	266
Reduced Nodes	12
Reduced Edges	18
Branched Edges	6
Branched Index	0.3
Meshed Connectedness	0.1
Reduced Meshed Connectedness	0.37
Link Density	0.1
Average Node Degree	2.4
Hwang & Lansey Classification	Distribution Dense-Grid

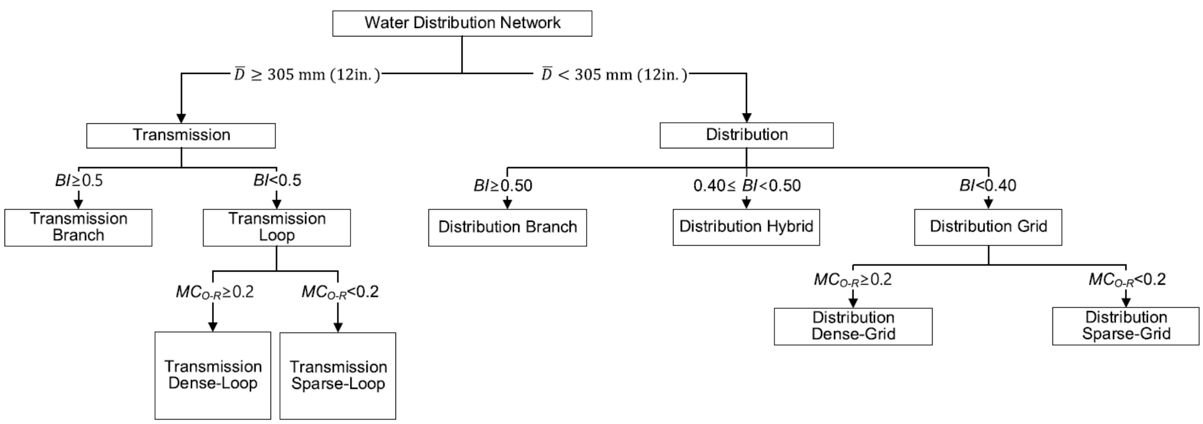


Figure 7. Water Distribution System Classification Flowchart (Hwang & Lansey, 2017)

Hwang H. & Lansey, K. (2015) "Water distribution system classification using system characteristics and graph theory metrics." *Journal of water resource planning and management* 143(12) https://doi.org/10.1061/(ASCE)WR.1943-5452.0000850

DETAILED DATA SUMMARIES

PHYSICAL ASSETS:

Asset Type:	# of Assets
Master Meters	0
Tanks	0
Pumps	0
Water Sources	1

NETWORK CHARACTERISTICS:

# Total Pipes:	34
# Junctions	27
# Reservoirs	1
# Tanks	0
# Regulating Valves	0
# Isolation Values	0
# Hydrants	Unknown
Elevation Data	YES

PIPE DATA:

Diameter (mm)	Length (m)
150	14,688
200	2,487
250	1,770
300	2,426
400	3,282
450	1,125
500	1,200
700	2,013

PUMP DATA:

Pump Horsepower	NO
Pump Curves:	NO

DATA FILE ATTRIBUTES:

ATTRIBUTE		UNITS
Pipe Length & Diameter	X	Meters and Millimeters
Pipe Age		
Node Elevation	X	Meters
Node Demand	X	LPS
Valves		
Hydrants		
Tank Levels		
Tank Volume		
PRVs		
WTP		
WTP Capacity		
Pump Data		