Comparison of automated control systems for main canal of Qazvin irrigation network

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Abstract

Agriculture, as larger water consumer, has an important role in water productivity. Due to poor performance, upgrading performance, improving water delivery management and increase flexibility in order to upgrading water productivity are necessary. One of effective methods to achieve these goals is irrigation network automation. In this paper, three automated control systems have been simulated by ICSS hydra dynamical model for main canal of Qazvin irrigation network in Iran.Amil check structure- Nyrpic gate intake structure, sluice gate check structure- P+PR algorithm- sluice gate intake structure, and pivot weir check structure – PID algorithm- Nyrpic gate intake structure are the automated control systems. At first, the ICSS model has been run for each automated control system in high variation operation scenario for main canal of Qazvin irrigation network. In this scenario high variation in inlet and intake discharge have been considered. Next, the performances of the control systems have been assessed by some criteria (Maximum Absolute Error (MAE), Integral of Absolute Magnitude of Error (IAE), and Effectiveness of delivered volume (DE Fvol)). Result show that the pivot weir check structure –PID algorithm- Nyrpic gate intake structure has the suitable performance in main canal of Qazvin irrigation network with less MAE and IAE, and more DE Fvol indexes.

Introduction

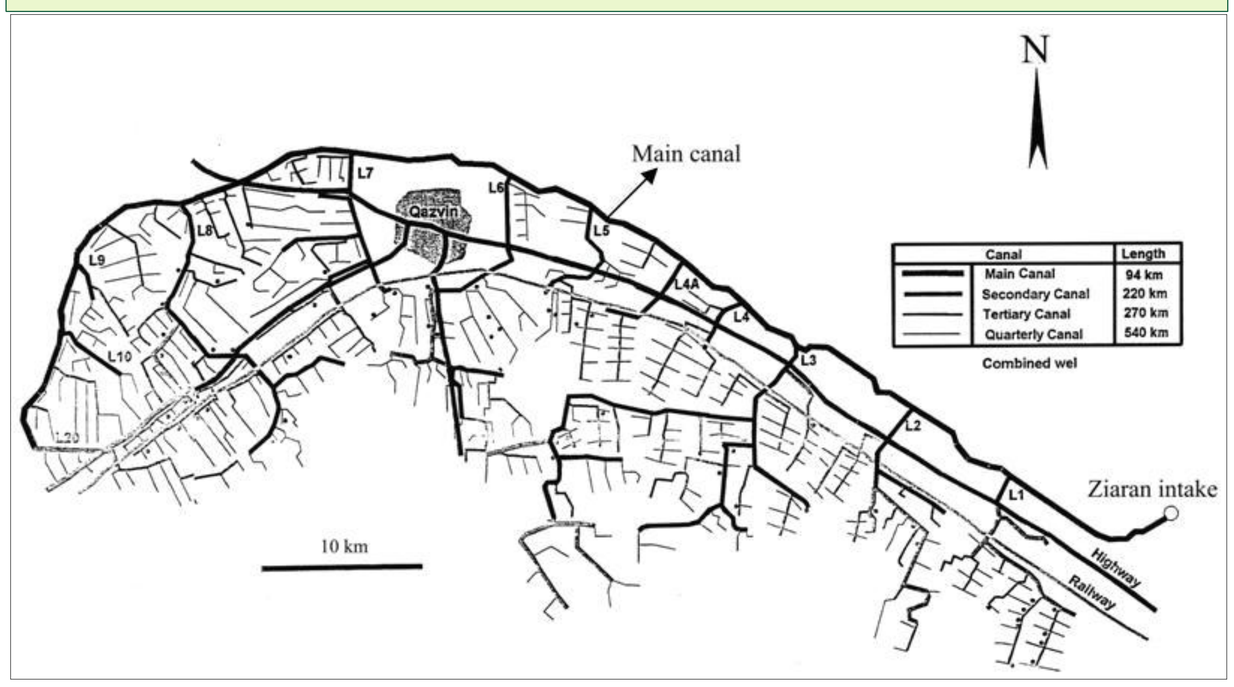
The low Irrigation network performance could be improved by application of control systems performance of control system designed for irrigation network.

The examples of researches about control systems

researcher	year
Clemmens and et al	1998
Clemmens and Whahlin	2004
Faruk Durdu	2010
Yizi et al	2012

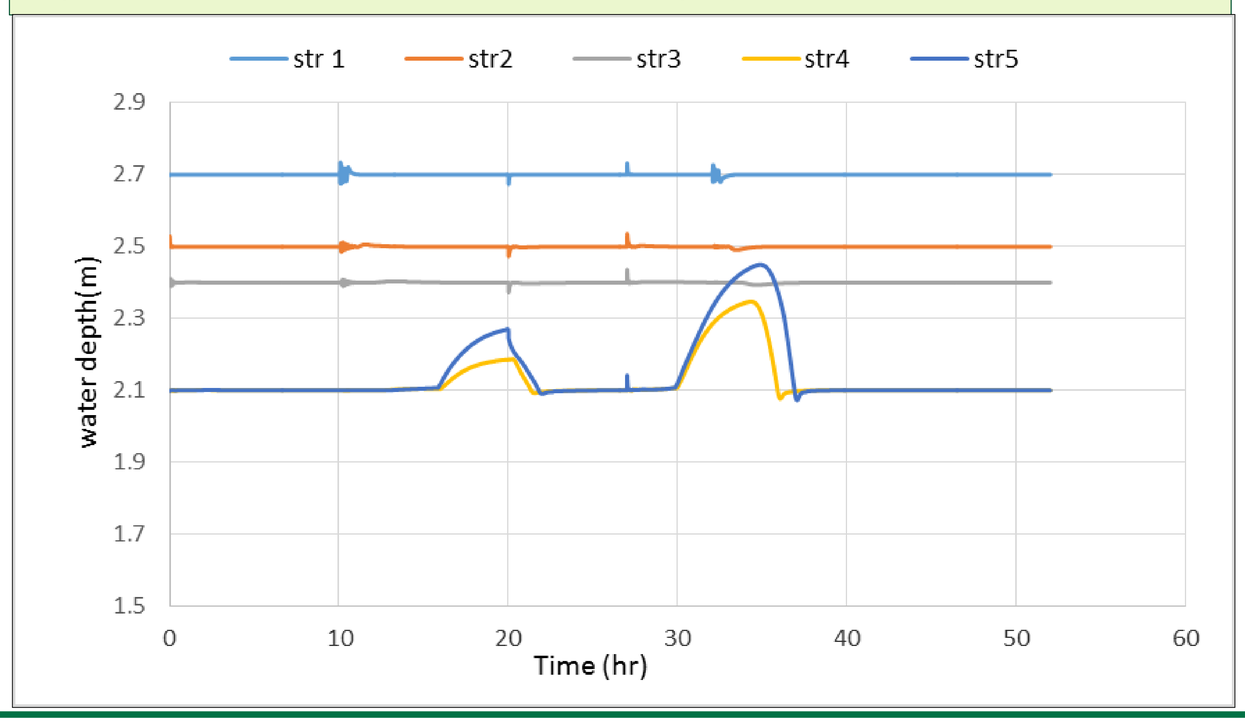
Case study

Qazvin Irrigation Network

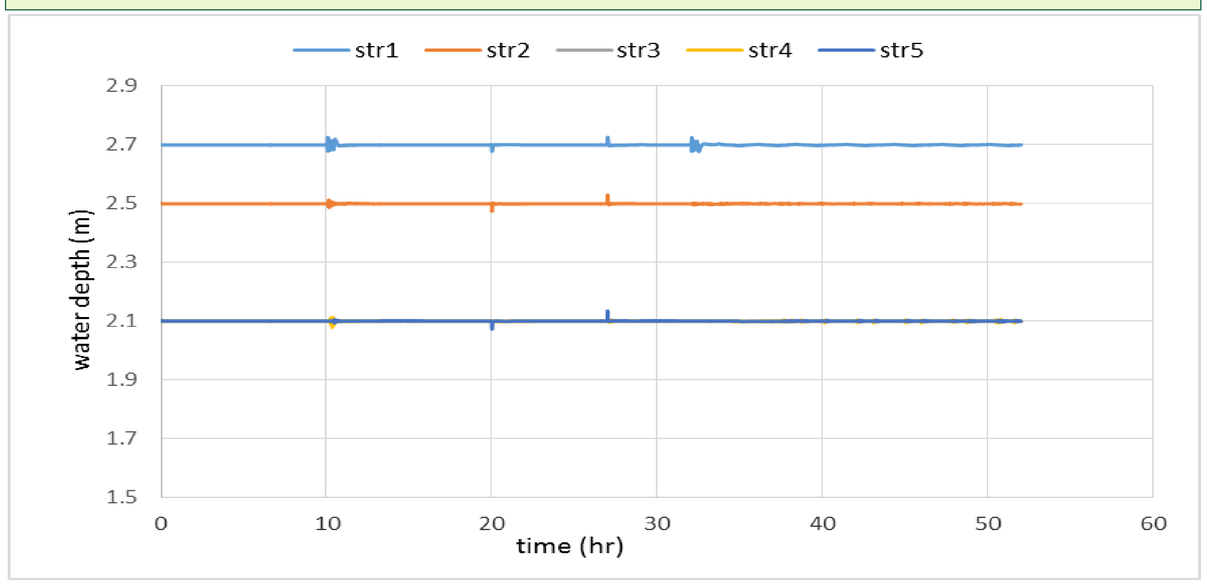


Result and discussion

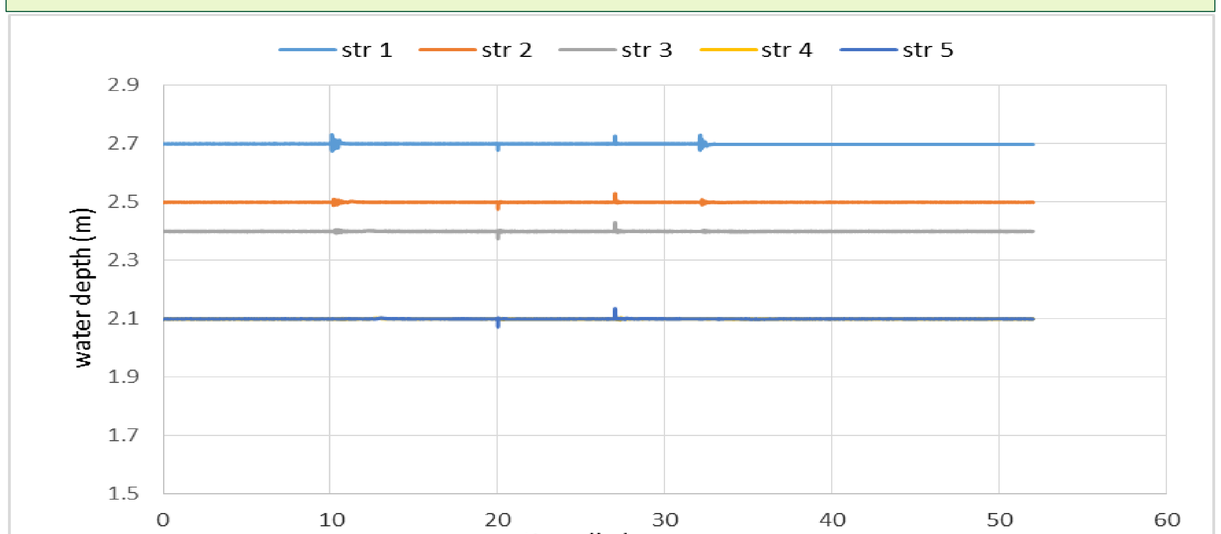
upstream water level in Amil check structure- Nyrpic gate intake structure control system



upstream water level in sluice gate check structure- P+PR algorithm- sluice gate intake structure control system



upstream water level in pivot weir check structure –PID algorithm- Nyrpic gate intake structure control system



The performance indexes for various control systems

		str 1	str 2	str 3	str 4	str 5	str 6
Amil-nyrpic	MAE	0.01	0.01	0.01	0.12	0.17	**0.51**
	IAE	0.00	0.00	0.00	0.01	0.02	**0.16**
	DE	**1**					
sluice-P+PR-sluice	MAE	0.01	0.01	0.02	0.01	0.02	**0.36**
	IAE	0.00	0.00	0.00	0.00	0.00	**0.10**
	DE	**0.74**					
pivot-PID-nyrpic	MAE	0.01	0.01	0.01	0.00	0.02	**0.00**
	IAE	0.00	0.00	0.00	0.00	0.00	**0.00**
	DE	**1**					

All control system could regulated in suitable manner. The problem in regulating water level increases in downstream structures that is the characteristic of upstream control system and is reasonable. For example, the MAE and IAE values increase by moving downstream structures or the water deviation from set point in 4 and 5 in in Amil check structure- Nyrpic gate intake structure control system is higher than other structures in this system.

The MAE and IAE values in Amil check structure- Nyrpic gate intake structure control system are more than other control system which means this control system performance is weaker than sluice gate check structure- P+PR algorithm- sluice gate intake structure and pivot weir check structure –PID algorithm- Nyrpic gate intake structure control systems. Also, these two indexes in pivot weir check structure –PID algorithm- Nyrpic gate intake structure control system are less than others.

Effectiveness of delivered volume has the least value in sluice gate check structure- P+PR algorithm- sluice gate intake structure control system which means Sluice gate as a intake could deliver more effective discharge.

Totally, The pivot weir check structure –PID algorithm- Nyrpic gate intake structure has the best performance.