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Deep Reinforcement Learning for Advanced Pressure Management in Water Distribution Networks

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Abstract : With the diverse nature of urban cities, customer demand patterns, landscape topologies or even seasonal weather trends; managing our water distribution networks (WDNs) has proved a complex task. These unpredictable circumstances manifest as pipe failures, intermittent supply and burst events thus adding to water loss, energy waste and increased carbon emissions. Whilst these events are unavoidable, advanced pressure management has proved an effective tool to control and mitigate them. Henceforth, water utilities have struggled with developing a real-time control method that is resilient when confronting the challenges of water distribution. In this paper we use deep reinforcement learning (DRL) algorithms as a novel pressure control strategy to minimise pressure violations and leakage under both burst and background leakage conditions. Agents based on asynchronous actor critic (A2C) and recurrent proximal policy optimisation (Recurrent PPO) were trained and compared to benchmarked optimisation algorithms (differential evolution, particle swarm optimisation. A2C manages to minimise leakage by 32.48% under burst conditions and 67.17% under background conditions which was the highest performance in the DRL algorithms. A2C and Recurrent PPO performed well in comparison to the benchmarks with higher processing speed and lower computational effort.

Keywords : deep reinforcement learning, pressure management, water distribution networks, leakage management
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