Modeling Water Distribution Systems with Graph Neural Networks

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Water management has recently explored data-driven models to improve the adaptability of Water Distribution Systems (WDS) and strengthen decision making under uncertain conditions. The focus on these tools is motivated by the increasing availability of information and their proven performance in other fields. Modeling WDS with these techniques has been demonstrated to be useful; however, the traditional machine learning tools do not account for the graph structure present in the WDS. Considering this essential information offers the possibility to increase performance and to help the learning process. In this work, we introduce Graph Neural Networks (GNNs) for modeling WDS. GNNs are processing architectures to perform neural network tasks for data related to a graph. We first present the definitions and interpretations for using this framework in water networks. Then we compare the GNN approach against standard neural networks to predict an overall resilience metric in a benchmark system. The benefits of including the network structure in the learning process by the GNN are shown in the analysis of the obtained results.