Fundamental Model of Leak Dynamics in Water Pipe Networks Using Modified Consensus Model and Unsteady Bernoulli Equation

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Modeling a leak dynamics in water pipe networks is an extremely difficult problem due to the complexity of entangled network structure and has never been considered in literatures so far. In this work, we propose a fundamental model of the leak dynamics in water pipe networks consisting of the modified form of consensus model in vehicle platoon system and unsteady Bernoulli equation different from a general steady-state Bernoulli equation. The developed model shows a dramatic change of dynamics of the fluid velocity and pressure when a leak occurs in the pipe. The model is then validated with the experimental data obtained from a real water pipe network. The comparative result shows the proposed model can be used as a virtual water pipe network with pipe break due to the leak and used in developing a model-based leak detection algorithm such as estimation requiring a dynamic model of the system.