SMaRT-OnlineWDN D5.3: Concept for basic parameterization of the online simulation model

The proper estimation and regular update of model parameters is crucial for the actuality of a mathematical simulation representing the hydraulics and water quality of real physical water distribution system. Especially, when the model is running online uncertainties in model parameters can result in large discrepancies between model predictions and behaviour of the real system. Therefore, adequate techniques for data acquisition, maintenance and update of model parameters have to be developed. In what follows the process of choosing the parameters of the mathematical model will be called 'parameterization'. The parameterization consists of two steps. In the first (offline) step the components that are important for drawing a reliable picture of the real system are identified including: pipes and their characteristics, network topology, nodal elevations, control devices and pumps and their physical properties and operational modes, location of valves and hydrants and the customers including average consumption (normally retrieved from the billing system. Measurement data of the past are typically used for a first offline calibration of model parameters. In the second (online) step the model is confronted with 'live' data from the SCADA system. In this context, the measurements and operational states of devices are subdivided into three groups. The first group includes operational states of devices (valves states, rpm of pumps) that can be directly transferred to the corresponding parameter of the model. The second group concerns measurements that are used as boundary conditions in the model like tank inflows and water levels. Group one and two are the driving parameters of the model. The third group consist of measurements that can be used only indirectly for the online calibration of the model (see task 4). Examples are pressure heads at nodes and zone inflows that are used for adjusting the parameters that cannot be observed directly and are subject to uncertainty like demand values. An additional differentiation between the measurements can be done by distinguishing water quality sensors from hydraulic measurements. The objective of this document is to clarify which parameters belong to which group and the impact on calculation results and calibration needs. The paper starts with an introduction where the difference between model parameters and state variables of three technical systems (race car, bridge and supply system) is discussed. In the next chapter, firstly, the mathematical model of hydraulic slow transient calculations is introduced and, secondly, the model parameters and state variables are discussed from both, a mathematical perspective as well as practical considerations like acquisition of relevant data, update cycles and integration of the processes within the utilities operative task. The third chapter describes a three-step procedure for model simplification that is based on the decomposition of the network graph. The method can assist in the implementation of a model with the most appropriate level of detail for the online simulation application. As an alternative to non-reversible aggregation the approach can be also used for adaptive modelling. That means that based on a very detailed all pipe model simplified views on the system can be derived in real-time.

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