3

LEAK DETECTION USING INTERNAL PARAMETERS

This chapter continues the previous chapter's discussion on parameter-based leak detection techniques. Software or internal parameters-based FDD can be divided into physics-based or data-based methods. The discussion in this chapter is specifically on the introduction and implementation of potential data-based FDD techniques for leak detection in pipelines. Data here refers to the pipeline's internal variables like mass flow rate, pressure, and temperature.

DATA-BASED LEAK DETECTION TECHNIQUES

Data-driven FDD does not require simulating processes in real time. It depends on the system's measured variables. Data-driven techniques are preferred over model-based techniques when dealing with highly complex non-linear systems that are too difficult to be modelled in real-time. The challenge is to design a system that can acquire a considerable amount and the quality data [21]. Several data-driven techniques are available for fault detection. The potential techniques like model identification, neural networks, fuzzy networks, statistical, and support vector machines for leak detection in pipelines are discussed in the following.

Stochastic Model / Model Identification

A system can be modelled by linking together process variables in terms of mathematical expressions like conservation equations, state equations and thermodynamics laws. Such models are called analytical (physics-based) models [44]-[45] or white box models [46]. The alternative to physics-based models is directly based on experiments. Input and output signals from the system are recorded, and system parameters are found based on a chosen model structure. This is called system identification, system model identification, or parameter estimation [44],[47]-[48] or black-box models [46]. Figure 3.1, redrawn from a previous study by Eykhoff [49], summarises the basic steps in process modelling using an analytical and data-based approach. From the viewpoint of mathematics, system models obtained through parameter estimation can be deterministic or stochastic [47]. Deterministic models are developed based on process input and output measurements without considering noise (disturbances). While, stochastic models consider random noise in the model [47],[50].

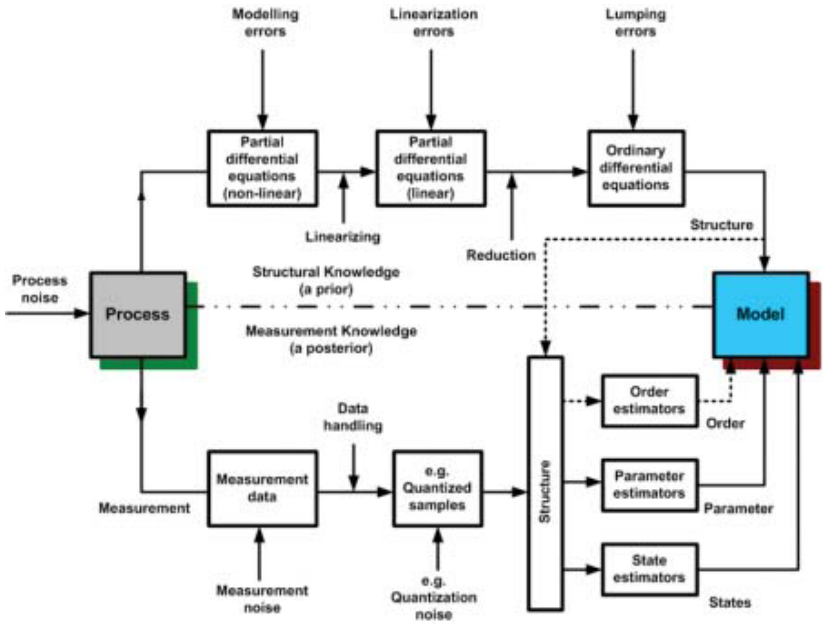

Figure 3.1 Theoretical and data-based process model identification approaches [49]