

Virtual sensor

In many processes, large amounts of data are collected. This data can be either controlled process parameters (temperature, pressure, pH...) as well measured process variables (product yield, concentration of impurities...).

Ideally, it should be possible to (1) directly measure all relevant process variables such as product yield and quality; and 2) control the process parameters such that the measured process variables are optimized. In reality, however, it may be impossible to directly measure all relevant process variables due to a lack of suitable sensors, the cost and time requirements, or the complexity of such measurements. Furthermore, the relation between the controlled process parameters and the relevant process variables may be too complex to allow the formulation of an optimal control strategy.

The lack of suitable sensors for a certain process variable may be overcome using available process parameters and variables together with multivariate data-analysis techniques to generate a virtual sensor. Such a virtual sensor utilizes a mathematical model of the relationship between the measured variables, possibly from several different data sources, and the process variable of interest to indirectly predict the current value of that process variable. A strong point of multivariate data-analysis methods is that they can be quite successful even in cases where the exact relationship between the measured variables and the process variable is quite complex and even unknown.

Proxedra's solution - Proxedra offers a totally integrated solution for data and knowledge management that covers the entire chain from data acquisition, management and analysis to data interpretation

and on-line control. The software's modular architecture makes it easy to add interfaces to various instruments, such that all variables needed to build up a virtual sensor can be measured and processed without resorting to the use of several independent software packages.

To generate a virtual sensor, a suitable model type must be selected and subsequently trained using known data. In this step, the data must be screened for abnormalities such that only valid data is used for the training of the model. Once a model has been trained, it is of utmost importance to validate the model, by comparing the predicted results with known results for data that was not used for training. Thereby, it is possible to determine the real accuracy of the model and to ensure that it is safe to use it. Proxedra's software simplifies all these important steps such that the user can concentrate on solving his or her problem rather than having to spend time on underlying mathematical details.

Although the model development must be made off-line, Proxedra's integrated software makes it a simple task to apply the resulting model on-line in real-time.

As a specific example relevant for the Biotech industry, we here present the generation of a virtual sensor for growth rate. In a bioprocess plant, measurements are collected on stirrer speed, oxygen level, and added nutrients. To measure the biomass concentration requires an off-line analysis. If instead a virtual sensor is calculated, it uses the measured process parameters together with gas-sensor data to predict the biomass concentration on-line.

CASE – VIRTUAL SENSOR

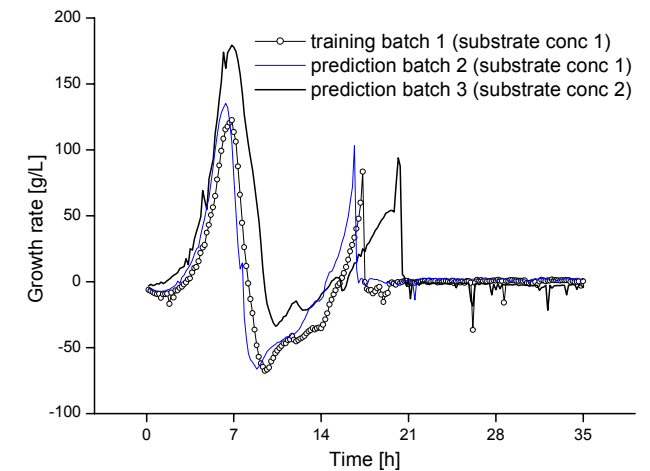


Figure 2: Predicted growth rate for three separate batches. Batch #1 was used for training of the virtual sensor.