Designing models for online use with Modelica and FMI

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Model-based online applications such as soft-sensing, fault detection or model predictive control require representative models. Basing models on physics has the advantage of naturally describing nonlinear processes and potentially describing a wide range of operating conditions. Implementing adaptivity is essential for online use to avoid model performance degradation over time and to compensate for model imperfection. Requirements for identifiability and observability, numerical robustness and computational speed place an upper limit on model complexity. These considerations motivate that models for online use should be balanced-complexity, physically based with online adaption possible.

Despite potential benefits, the effort required to implement balanced-complexity models, particularly at large scales, may deter their use. This paper presents techniques used in the design of balanced-complexity models. A Modelica-based approach is chosen to reduce implementation effort by interfacing exported Modelica models with application code by means of the generic interface FMI. The suggested approach is demonstrated by parameter estimation for a process of offshore oil production: a subsea well-manifold-pipeline production system as illustrated in Figure 1.

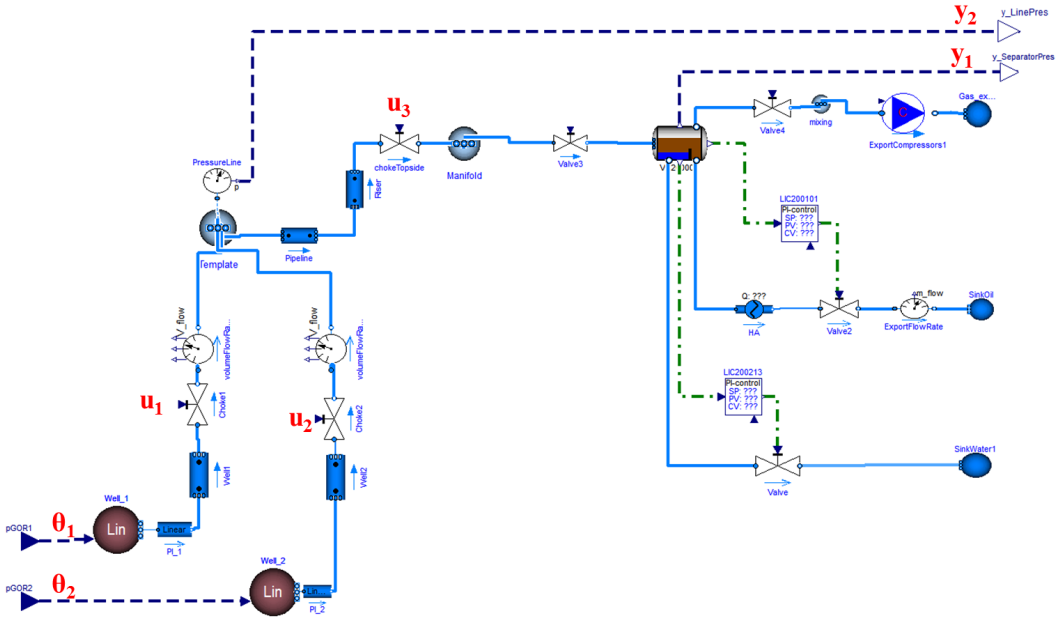

Figure 1: Overview subsea-pipeline-riser-separator system as implemented in DYMOLA, with piping (solid), handles to the estimator via FMI (dashed), and PI-control (dashdot).