Nonlinear State Estimation with an Extended FMI 2.0 Co-Simulation Interface

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Abstract

In this paper we propose a method how to automatically utilize continuous-time *Modelica* models directly in nonlinear state estimators (Figure 1). The approach is based on an extended *FMI 2.0 Co-Simulation Interface* that interacts with the state estimation algorithms implemented in a *Modelica* library (Figure 2). Besides a short introduction to *Kalman Filter* based state estimation, we give details on a generic interface to cooperate with FMUs in *Modelica*, an implementation of nonlinear state estimation based on this interface, and the *Dymola* prototype used for the evaluation. Finally we show first results in a tire load estimation application (Figure 4) for DLR's robotic electric research platform *ROMO* (Figure 3).

Keywords: FMI 2.0 Co-Simulation, FMU, Event Handling, Inline Integration, Kalman Filter, State Estimation, Moving Horizon Estimation, Tire Load Estimation

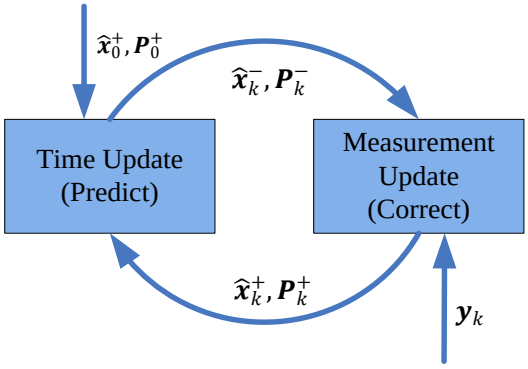

Figure 1: Principle of Kalman Filter based Estimation

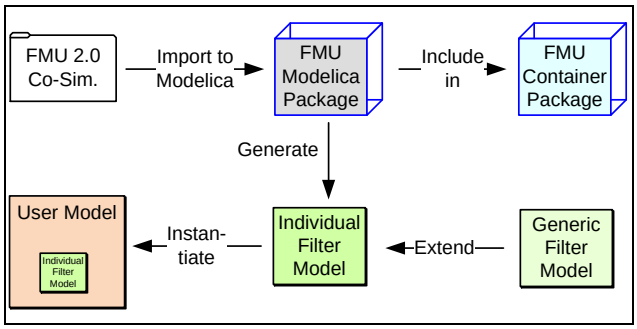

Figure 2:Process flow to generate a state estimator based on an FMU

Figure 3: ROMO on the four post test rig

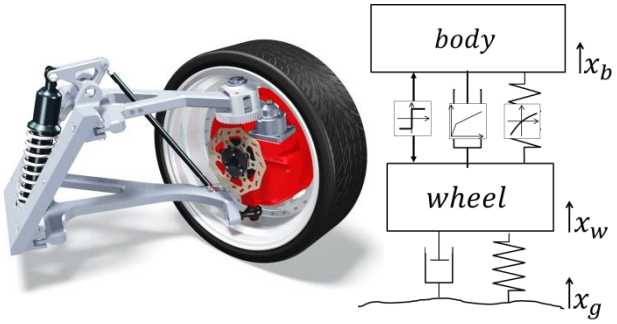

Figure 4:left: the "Wheel Robot" concept, right: nonlinear two mass system