Derivative-free Parameter Optimization of Functional Mock-up Units

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Representing a physical system with a mathematical model requires knowledge not only about the physical laws governing the dynamics but also about the parameter values of the system. The parameters can sometimes be measured or calculated, however some of them are often difficult or impossible to compute directly. Finding accurate parameter values is crucial for the accuracy of the mathematical model.

In this paper, we present applications of derivative-free optimization algorithms to parameter estimation in the JModelica.org platform. The implementation allows the underlying dynamic system to be represented as a *Functional Mock-up Unit (FMU)*, thus enables parameter estimation of models exported from modeling tools compliant with the *Functional Mock-up Interface (FMI)*.

Examples are provided in order to demonstrate the implemented functionality. In Figure 1, the Nelder-Mead simplex method [1] has been applied to a Furuta pendulum system where friction coefficients have been optimized in order to minimize the difference between measurements and the simulated response from the mathematical model of the system. In addition, an industrial benchmark where the algorithm is used to calibrate a model based on the Engine Dynamics Library (EDL) for a 13 liters Volvo truck engine is presented [2].

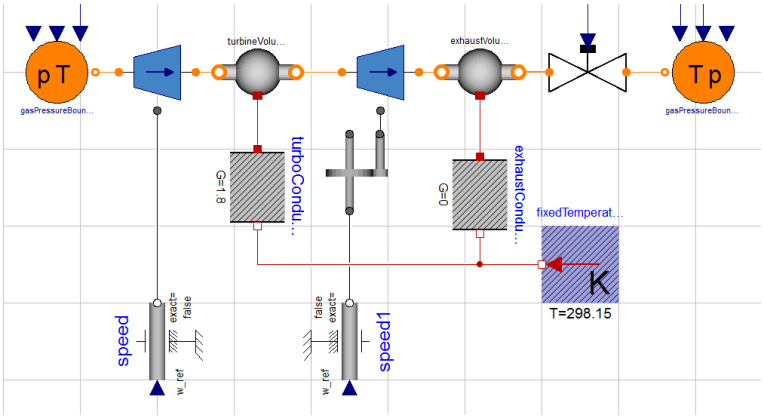

Figure 1: Component diagram of the Volvo truck engine calibrated in the paper.

References

[1] A.R. Conn, K. Scheinberg, and L.N. Vicente. *Introduction to Derivative-Free Optimization*. Mps-siam Series on Optimization. Society for Industrial and Applied Mathematics/Mathematical Programming Society, 2009.

[2] J. Dahl and D. Andersson. Gas exchange and exhaust condition modeling of a diesel engine using the Engine Dynamics Library. In *In 9th International Modelica Conference 2012*. Modelica Association, 2012.