# Multi-objective optimization of dynamic systems combining genetic algorithms and Modelica: Application to adsorption air-conditioning systems

Uwe Bau[1] Daniel Neitzke[1] Franz Lanzerath[1] André Bardow[1]

[1]Institute of Technical Thermodynamics, RWTH Aachen University, Germany,
andre.bardow@ltt.rwth-aachen.de

The Modelica language enables the fast and convenient development of physical simulation models. These models are often used for simulation studies. The re-use of simulation models for optimizations requires model adaption, additional tools or libraries. In this paper, we present a framework to connect Modelica models developed in Dymola to MATLAB's optimization toolbox. As optimization algorithm, we use a multi-objective genetic algorithm. With such a black-box approach, the user only has to define the design parameters and their corresponding bounds, as well as the objective functions. The optimization procedure and the implemented link between Dymola and MATLAB are displayed in Figure 1. Modelica script files execute the Dymola simulations and MATLAB's *gamultiobj* function evaluates the design parameters and objectives. The optimization procedure is tested for the design of an adsorption air-conditioning system. The two key performance indicators of this case study are the mobile coefficient of performance $COP_{mobile}$ and the specific cooling power SCP. Both of these indicators are objectives to be maximized. In order to properly assess the benefit of a genetic optimization algorithm, we compare the resulting solutions (Figure 2, shades of blue) to those of a simple full factorial design (red). 40 iterations (generations) of the genetic algorithm correspond to the number of simulations of the full factorial design. The optimization procedure outperforms the full factorial design regarding solution diversity, objective quantity and objective quality. Thus, the necessary computation time can be significantly reduced to obtain comparable results. The presented framework provides convenient access to optimization methods leading to improved solutions for engineering practice.

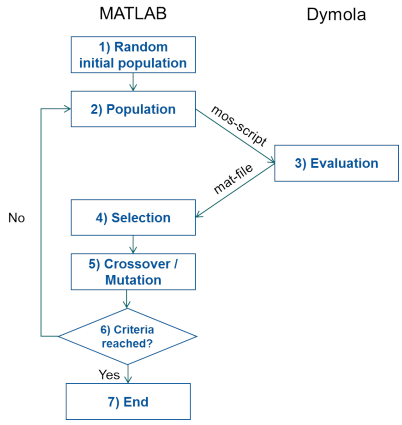


**Figure 1.** Procedure of black-box optimization linking Dymola with MATLAB.

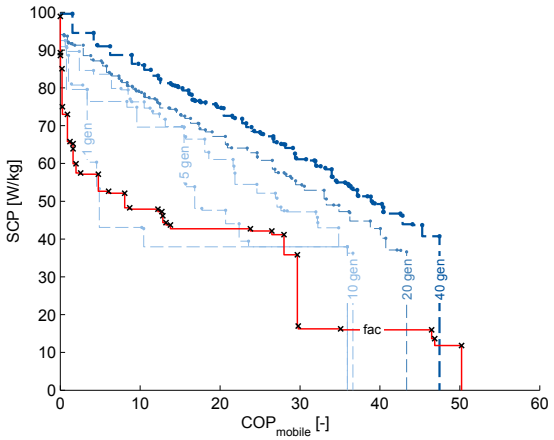


**Figure 2.** Pareto solutions of genetic algorithm (blue) and full factorial design (red).