ThermoCycle: A Modelica library for the simulation of thermodynamic systems

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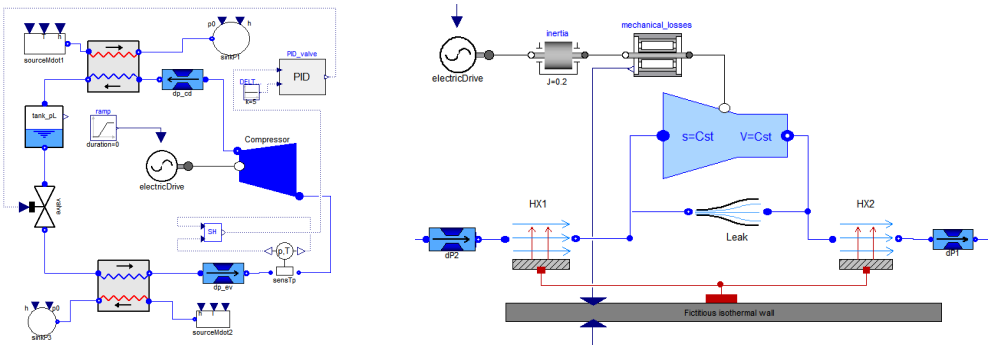
This paper presents the results of an on-going project to develop ThermoCycle, an open Modelica library for the simulation of low-capacity thermodynamic cycles and thermal systems. Special attention is paid to robustness and simulation speed since dynamic simulations are often limited by numerical constraints and failures, either during initialization or during integration. Furthermore, the use of complex equations of state (EOS) to compute thermodynamic properties significantly decreases the simulation speed.



(a) Model of an R407c heat pump (b) Semi-empirical compressor model

Figure 1: Components of the ThermoCycle library

The currently available Modelica solutions for computing organic fluid properties are limited to non-open-source databases. In order to propose a fully open-source tool, ThermoCycle has been coupled to CoolProp, an open-source library developed at the University of Liège.

Furthermore, to enhance the performance and the robustness of the ThermoCycle library, different numerical methods have been implemented and tested. Some are implemented at the Modelica level while others require a modification of the thermodynamic properties of the working fluid and are therefore implemented into CoolProp. It should also be noted that some of these methods have already been proposed in the literature, while some others are new. In this paper, the approach adopted in the library to overcome the challenging task of dynamic modelling of thermodynamic cycles is presented and discussed.