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Application of a reduced dynamic model to the control of a refrigerating cycle

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Today, many dynamic models of compression cycles are available in the literature. The most valuable and accurate of them is based on the local description of the physical phenomena in heat exchangers coupled with the modelling of the other components as compressor or expansion valves. The use of this type of model to control refrigerating plants should consistently improve their performances in terms of both refrigerating capacity and energy consumption. Unfortunately, these complex models are not used for real time control of systems because they require large computation duration.

This paper presents a way to face this limitation. A global distributed parameter model of a water/water refrigerating unit is described. A reduced model is proposed and consists in a reduced number of ordinary differential equations directly usable for the simulation of the system. In particular the explicit form of the equations shows that the main dynamic characteristic of the two-phase region in the evaporator should be described with a mass balance, which is fundamental for the control of the superheat and, consequently, for the control of the whole system.

The reduction procedure is presented as well as the way to apply it for the control of the loop. The complete and the reduced models are compared to experimental values and the improvement of this control algorithm on the energy performances of the installation is discussed.