

# Nonconvex Model Predictive Control for Commercial Refrigeration

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- [IJC paper](#)
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We consider the control of a commercial multi-zone refrigeration system, consisting of several cooling units that share a common compressor, and is used to cool multiple areas or rooms. In each time period we choose cooling capacity to each unit and a common evaporation temperature. The goal is to minimize the total energy cost, using real-time electricity prices, while obeying temperature constraints on the zones. We propose a variation on model predictive control to achieve this goal. When the right variables are used, the dynamics of the system are linear, and the constraints are convex. The cost function, however, is nonconvex due to the temperature dependence of thermodynamic efficiency. To handle this nonconvexity we propose a sequential convex optimization method, which typically converges in fewer than 5 or so iterations. We employ a fast convex quadratic programming solver to carry out the iterations, which is more than fast enough to run in real-time.

We demonstrate our method on a realistic model, with a full year simulation and 15 minute time periods, using historical electricity prices and weather data, as well as random variations in thermal load. These simulations show

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substantial cost savings, on the order of 30%, compared to a standard thermostat-based control system. Perhaps more important, we see that the method exhibits sophisticated response to real-time variations in electricity prices. This demand response is critical to help balance real-time uncertainties in generation capacity associated with large penetration of intermittent renewable energy sources in a future smart grid.