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Optimization of PD Controller based on ARMAX Model for Vapor Compression Refrigeration System using R600a Refrigerant

Abstract

The research undertaken in this paper is to investigates the difference in approaches to the modelling, design and implementation of an adaptive controller tuned using Auto-Regressive Moving-Average Exogenous (ARMAX) 2,1,1 model in an environment simulated in SIMULINK, applied to a variable speed compressor vapor compression refrigeration system running R600a refrigerant. A vapor compression refrigeration system is chosen for this paper research as it's the most commonly used type of refrigeration system in all over the world, either for domestic, commercial or industrial application. The refrigeration system consists of a condenser, an expansion valve, an evaporator and a compressor which are modified from a fixed speed compressor to a variable speed compressor. The compressor was modified to be able to accommodate the usage of R600a refrigerant. R600a refrigerant has a thermophysical properties which can roughly be define as a slight change in pressure will result in a drastic change in temperature [1]. To be able to control the pressure for R600a with precision, an optimized adaptive controller is required. For the purpose of the simulation, the refrigeration system mathematical model is simplified to a linear polynomials ARMAX model. This is to reduce the complexity of the control design strategies, which in term improve the implementation of the new controller design. The optimization of the adaptive controller design, its simplicity of implementation, speed of convergence and robustness are concluded at the end part of the paper.

Keywords

Auto-Regressive Moving-Average Exogenous (ARMAX) model; Proportional-Derivative (PD) controller; R600a refrigerant; Vapor Compression Refrigeration System (VCRS)