Optimizing Seasonal Cooling and Heating Performance of Unitary Heat Pumps using Variable Speed Compressors and Fans PI: Eckhard A. Groll

Objective:

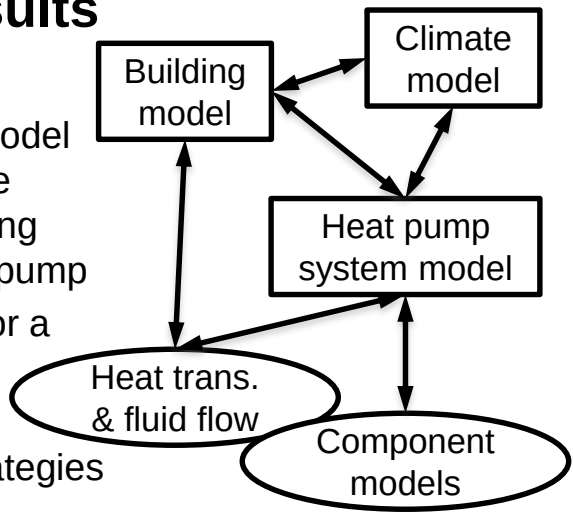
- To investigate sensitivity of heat pump seasonal efficiencies based on variable capacity components to obtain optimized configurations.

Problem:

- Optimization of capacity modulated systems is a complex function of component design and matching, control strategies, and end-user choices

Expected Results / Impact:

- Validated system model that also models the thermal zone(s) being served by the heat pump
- Optimized design for a capacity modulated heat pump system
- Efficient control strategies



Approach:

1. Development of detailed simulation model of capacity controlled heat pump system
2. Sensitivity analysis of operating parameters using model
3. Model validation by laboratory experiments or field testing
4. Exercise system model to optimize system and predict its seasonal performance

Schedule

Tasks / Months	1	2	3	4	5	6	7	8	9	10	11	12
Project startup	■											
Model development		■	■	■	■							
Sensitivity analysis				■	■							
Model validation						■	■	■	■			
System simulation										■	■	
Final report												■

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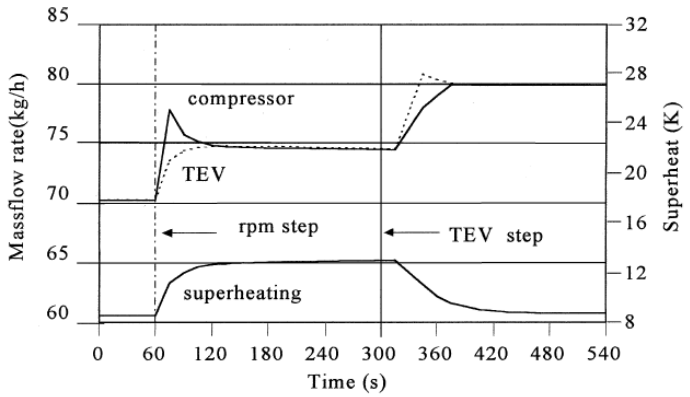
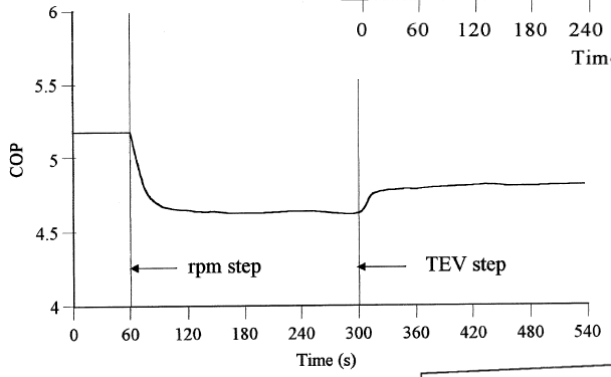
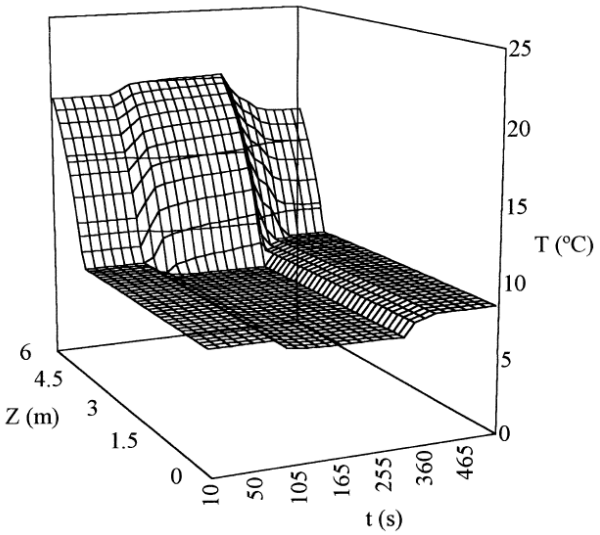
Figure 1 →





← Figure 2

Figure 3 →



- Typical model outputs from Koury *et al.* (2001)
- Dynamic response recorded after step change
  - » Compressor rpm
  - » Expansion valve flow area

- Figure 1: Refrigerant mass flow rate and compressor suction superheat
- Figure 2: System performance
- Figure 3: Local refrigerant temperature along evaporator flow length

- Dynamic interactions among components
  - » System performance at part-load and off-design conditions
  - » Accurate seasonal performance
  - » Optimal control strategies

Koury, R.N.N., Machado, L., & Ismail, K.A.R. (2001). Numerical simulation of a variable speed refrigeration system. *International Journal of Refrigeration, 24*(2), 192-200. doi:10.1016/S0140-7007(00)00014-1

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