



Carrier Uses VisSim for HVAC Design

Dynamic Simulation of a Reciprocating Chiller

Carrier Corporation, a division of United Technologies Corporation, is one of the largest manufacturers and distributors of heating, ventilating, and air conditioning (HVAC) equipment worldwide. For more than five years, Carrier has been committed to using VisSim to model, simulate, and validate product designs ranging in scope from single zone air conditioners to hundred-ton chillers used in hospitals, university campuses, and office complexes.

Richard Kolk, senior staff engineer in controls and simulation, had this to say about VisSim:

"Due to its power, flexibility, ease of use, and low cost, VisSim has been Carrier's choice for system modeling, simulation, data acquisition, and rapid prototyping for each of the past five years. Carrier uses VisSim to develop and test all of its electronic controls and depends on the resulting shortened development times to continually merge new technology into its products. Products which would have taken two to three years to develop in the past are now routinely completed using VisSim in less than one year."

Version 3.0 further extends VisSim's power to cover both scalar and vector block diagrams, including such features as matrix operations, matrix output displays, expression blocks, and a model tree. These features enable complex real-world systems to be rapidly modeled, simulated, and debugged. Modeling of essential matrix-based control elements, such as state-space controllers, observers, and Kalman filters becomes particularly easy with the new matrix operations."

A recent VisSim modeling effort conducted by Dr. Fred Cogswell, senior scientist at United Technologies Research Center, focused on the development of a reciprocating chiller model for simulating faults. The reciprocating chiller consists of two refrigerant circuits, each with the following components:

Carrier 30GT reciprocating chiller. The controller was designed using VisSim.



- One to four reciprocating compressors in parallel to compress the refrigerant vapor
- A water-cooled or air-cooled condenser to remove heat from the high pressure refrigerant and condense it to liquid
- A stepper motor controlled expansion valve to meter the refrigerant flow as it goes from high to low pressure
- An evaporator to transfer heat from the chilled water to the refrigerant, thus boiling the refrigerant to vapor while providing cooling

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The model, which consists of approximately 6,000 blocks, performs a dynamic simulation of the chiller system tracking the migration of refrigerant between components as well as the control interactions. It runs at an update time of one second in order to maintain stability between the components; however, on a Pentium computer it is capable of running many times faster than real time.

This reciprocating chiller model represents one of the many ways Carrier Corporation uses VisSim to significantly decrease its design cycle time.

Application: HVAC