CENTER FOR ENVIRONMENTAL ENERGY ENGINEERING
UNIVERSITY OF MARYLAND COLLEGE PARK

Integrated Systems Optimization Consortium

Leader in research and education in the field of distributed energy conversion systems

The Integrated Systems Optimization Consortium (ISOC) at the Center for Environmental Energy Engineering (CEEE), University of Maryland, specializes in the research and development of modeling and optimization tools for energy conversion systems.

CEEE Expertise

- Alternative Refrigerants & Cooling Technologies
- Compressor & heat exchanger technology
- Thermo physical properties of fluids
- Energy conversion cycles
- Thermal systems integration and optimization

Benefits for Partners

- Fast performance evaluation of thermal systems and design alternatives
- Optimization of thermal systems for cost and performance, with the help of a unified framework for modeling, validation and optimization
- Access to validated thermal system and component models and simulation tools
- Software component development and integration assistance provided by professionals

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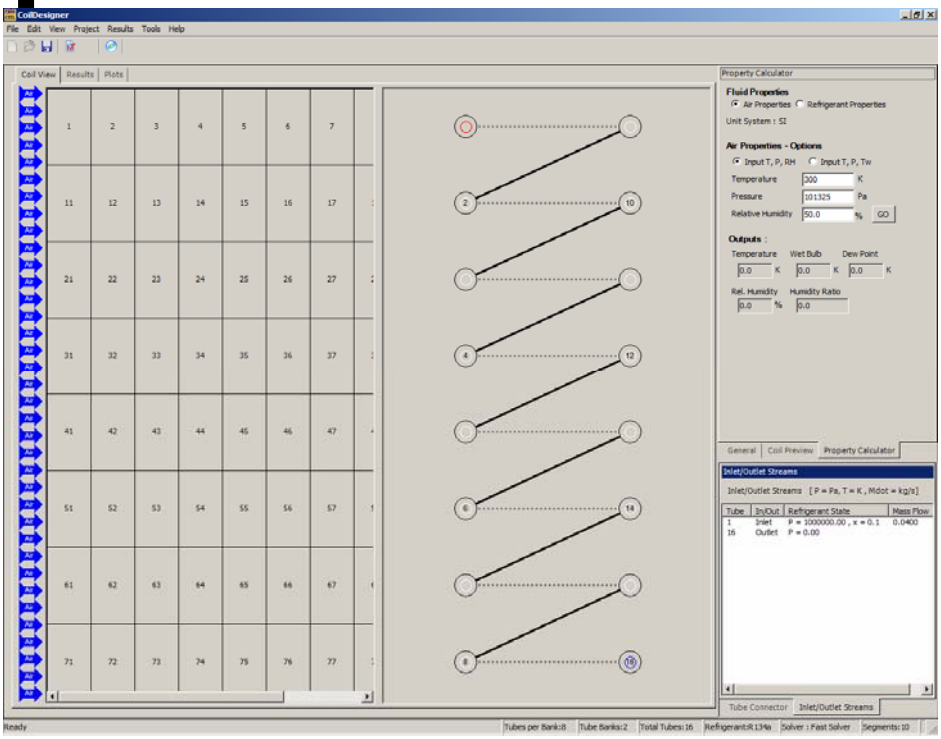
CoilDesigner

A sophisticated tool for design and optimization of air-cooled heat exchangers



- A highly customizable tool for simulating tube-fin, micro-channel, wire-fin and flat tube coils.
- Model validated with experimental data.
- Flexible tube-circuitry. Number of tube rows and columns limited by available computer memory.
- User can connect tubes on-screen via consecutive mouse-clicks and can undo connections.
- Can account for 2-dimensional air mal-distribution depending on inputs.
- Popular heat-transfer (23), pressure drop (17), and void fraction (15) correlations implemented in the tool for different refrigerant phases. Refrigerant specific (e.g., CO2 supercritical) correlations also implemented.
- Ability to add user-defined correlations (for heat-transfer, pressure drop and fin efficiency) in the form of external libraries and polynomial coefficients.
- Support for multiple fin types and fins with holes with 6 fin efficiency correlations.
- User can input correction factors (multipliers) for heat transfer coefficients and pressure drops.
- Detailed results can be viewed in the program and plotted and can be exported to a spreadsheet program and optionally in formatted text. Tube circuitry can be printed and /or saved to a text file.
- Coil configurations can be saved in portable data format, such that other tools can use components designed with CoilDesigner.
- Built-in features include Unit Converter & Refrigerant Thermo-physical Property Calculator based on NIST REFPROP 7.0.
- Ability to perform parametric analysis and create plots. Dimensions, refrigerant and air state can be varied.
- Can be coupled with Single/Multi-Objective Genetic Optimization Algorithms for optimization of cost, performance, fan power consumption etc. Results of such studies published.
- Interfaces and development assistance provided by ISOC personnel.

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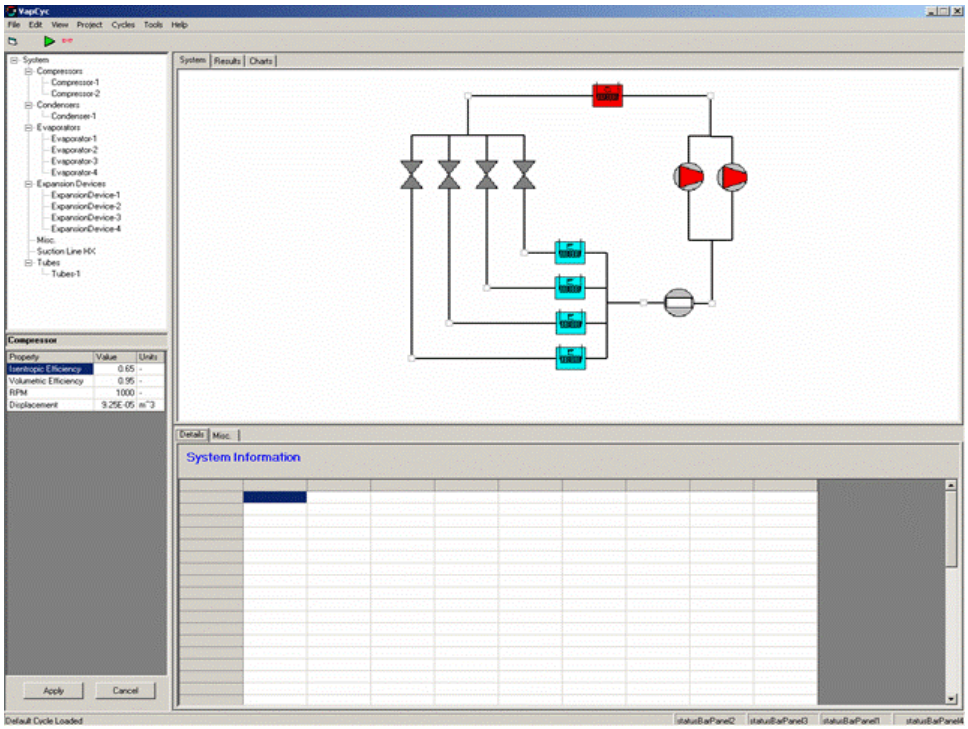
VapCyc

An advanced vapor compression cycle simulation tool



- VapCyc is an advanced vapor compression cycle, charge dependent simulation tool.
- Ability to change and add system components (evaporator, compressors, etc.) on the fly. Connecting tubes and suction-line heat exchanger can be accounted for.
- Large variety of component models including accumulator, SLHX, two stage compressor, intercooler, fans, and tubes
- Built-in single and multiobjective genetic optimization algorithms. System parameters such as cost, manufacturability, reliability and weight can be used in optimization.
- Ability to model CO2 cycles and two-stage cycles.
- Interfaces provided along with the tool, so that users can develop their own components for use in VapCyc. User defined components developed using the CEEE Component Standard, can be loaded into the cycle at runtime
- Input/output with spreadsheet program.
- Ability to use CoilDesigner files as input for heat exchanger component.
- Features ARI 10 Coefficient Compressor Model with the coefficients stored in a database that is easily appended.
- Fan models can be coupled with certain HX models. Fan curve coefficients are stored in a database.
- Ability to save and load built cycles.
- Multiple solver options include system charge specified, system sub-cooling specified, and system discharge pressure specified. Robust solver that is tested on variety of cycle configurations with a number of different operating conditions.
- Parametric analysis with plotting.
- Various modes of operation include residential air conditioning, heat pumping, and low, mid and high temperature refrigeration.

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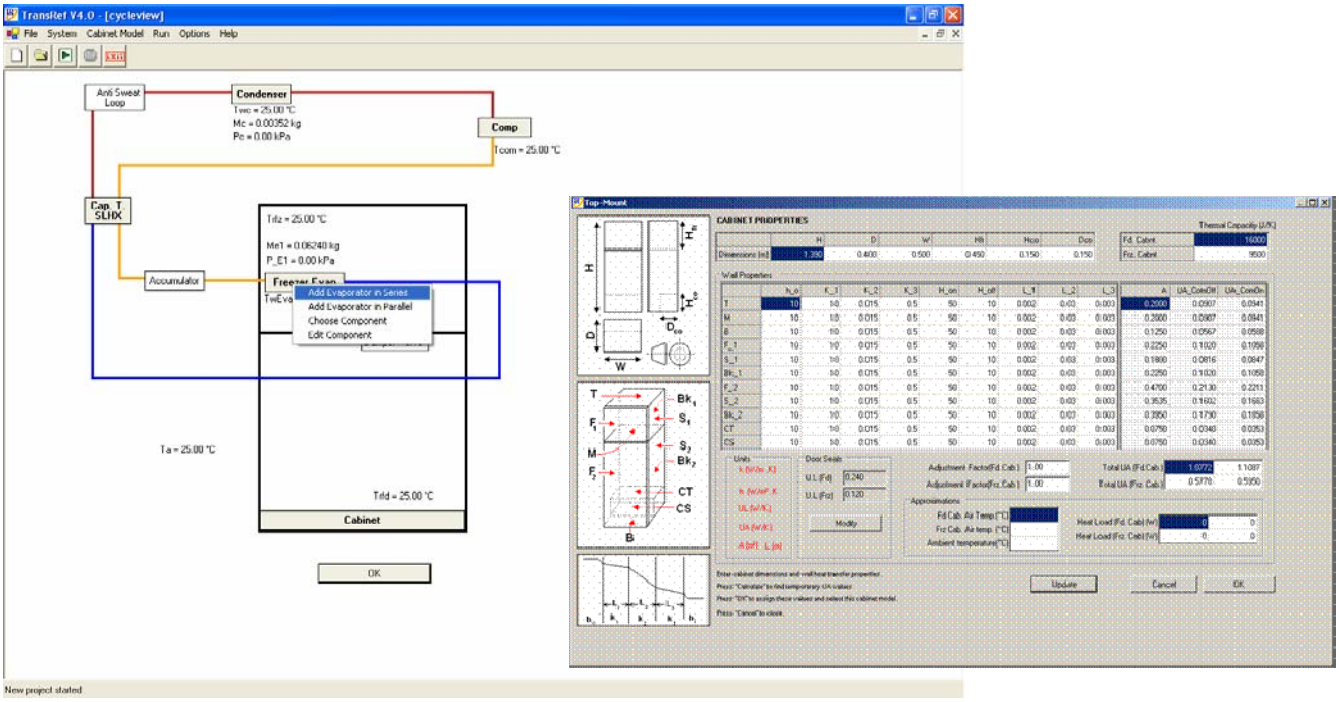
TransRef

An advanced transient refrigerator simulation tool



- Component based transient simulation tool for refrigerators.
- Component models can be changed on the fly.
- User defined component models can be developed using the CEEE Component Standard and can be loaded into the program
- Ability to model multi-evaporator cycles.
- Includes detailed cabinet models for different refrigerator applications. Is being extended to automotive passenger cabins.
- Calculates different state points and energy consumption at each time step. Provides pull-down time information.
- Ability to add and test user defined control algorithms and change settings during transient simulation. Allows cascading of multiple control algorithms.
- Inputs and outputs at each time step can be exported to a spreadsheet for further post-processing.
- Coming Soon: Ability to model CO_2 cycles.

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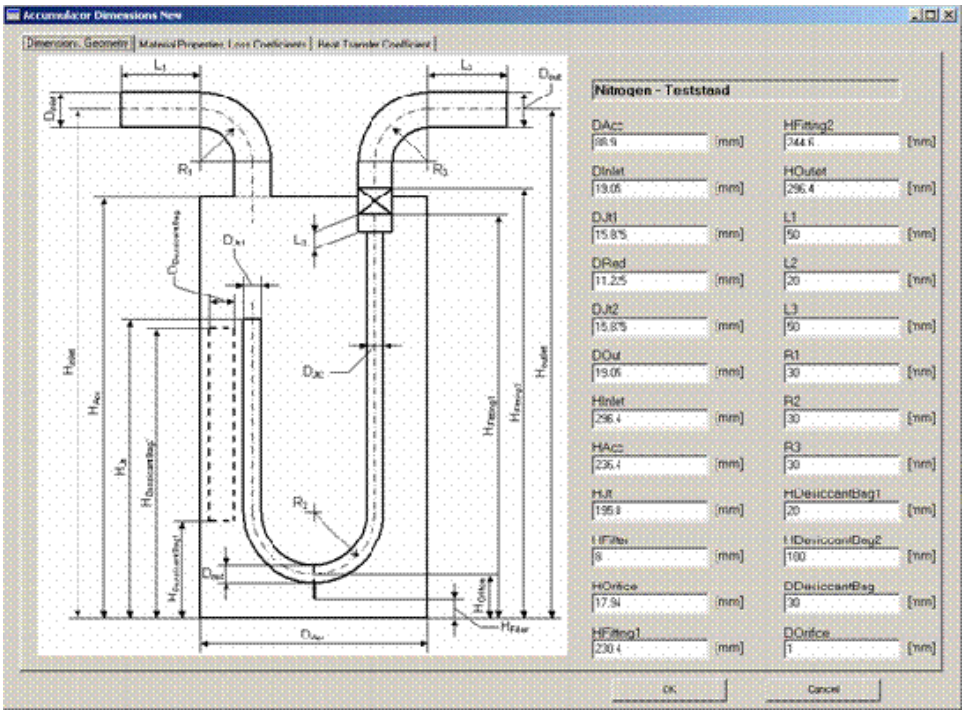
AccuSim

An automotive accumulator simulation tool



- Detailed simulation of an automotive accumulator.
- Calculates outlet quality, refrigerant and oil retention and pressure drops.
- Model validated with experimental data.
- Ability to add user-defined loss-coefficients for pressure drops in the form of linear and exponential equations.
- Input/output with spreadsheet program to assist in parametric analysis.

Other Supporting Tools

- CEEEProps—A property routine library based on the NIST REFPROP 7.0 property database, that provides consistent refrigerant properties in all the modeling tools
- WinUnit , WinAir and WinCO2 are standalone programs for unit conversion, air properties and CO_2 properties respectively.

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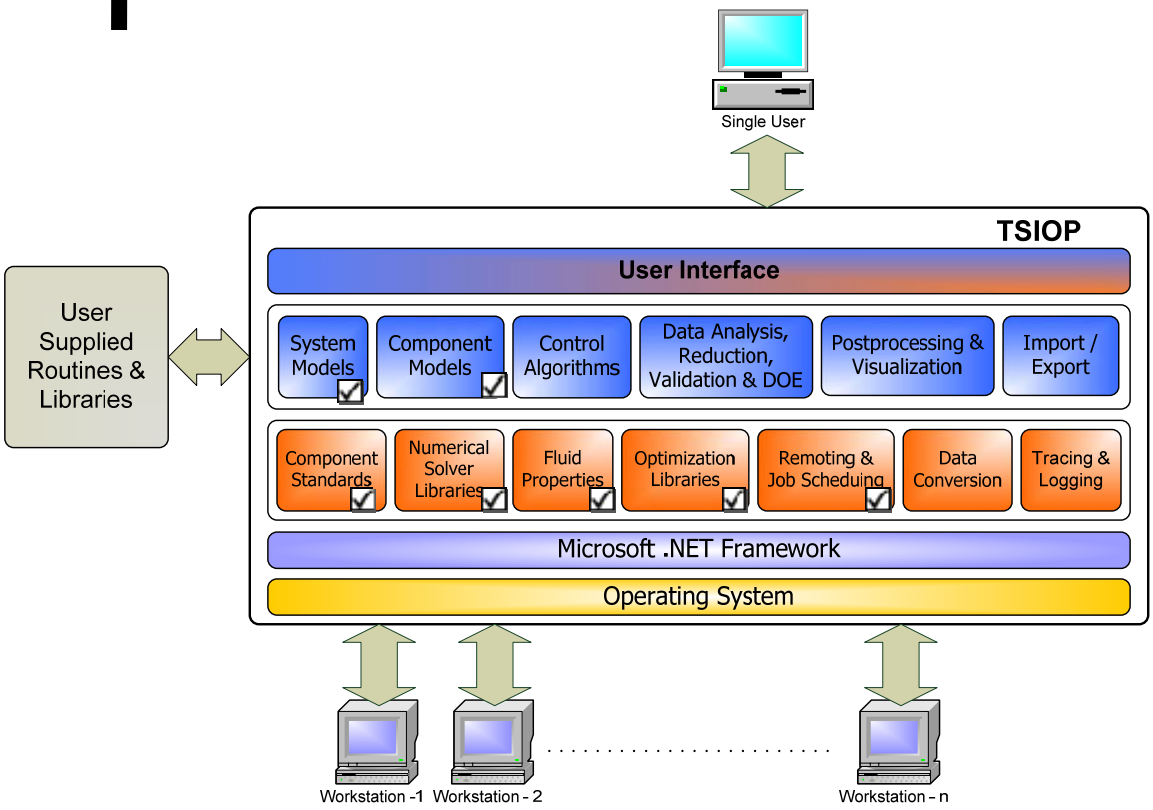
TSIOP

Thermal Systems Integration and Optimization Platform



- TSIOP is a long term effort. However the modules with check marks are available.
- The purpose of TSIOP is to facilitate the design and development, in a comprehensive manner, of thermal systems that are environment friendly, efficient, reliable and cost effective.
- A unified framework:
  - Designing cost effective and efficient thermal systems
  - Model new/existing systems and components
  - Simulate and optimize designs for first cost, operating cost, performance, reliability etc.
  - Simulate transient performance
  - Design and test control algorithms
  - Interfaces for data acquisition, analysis, reduction and validation
- The current version of TSIOP includes various system models, component models, numerical solvers, fluid properties, optimization libraries and job scheduler.
- TSIOP Job Scheduler is available to CEEE Members
  - Facilitates the distribution of repetitive computing jobs amongst a set of computers that are idle, especially during night time.
  - Allows the user to harness the power of distributed computing
  - Does not require special hardware or software.
  - Integration assistance is available from CEEE personnel for users interested in using the Job Scheduler.