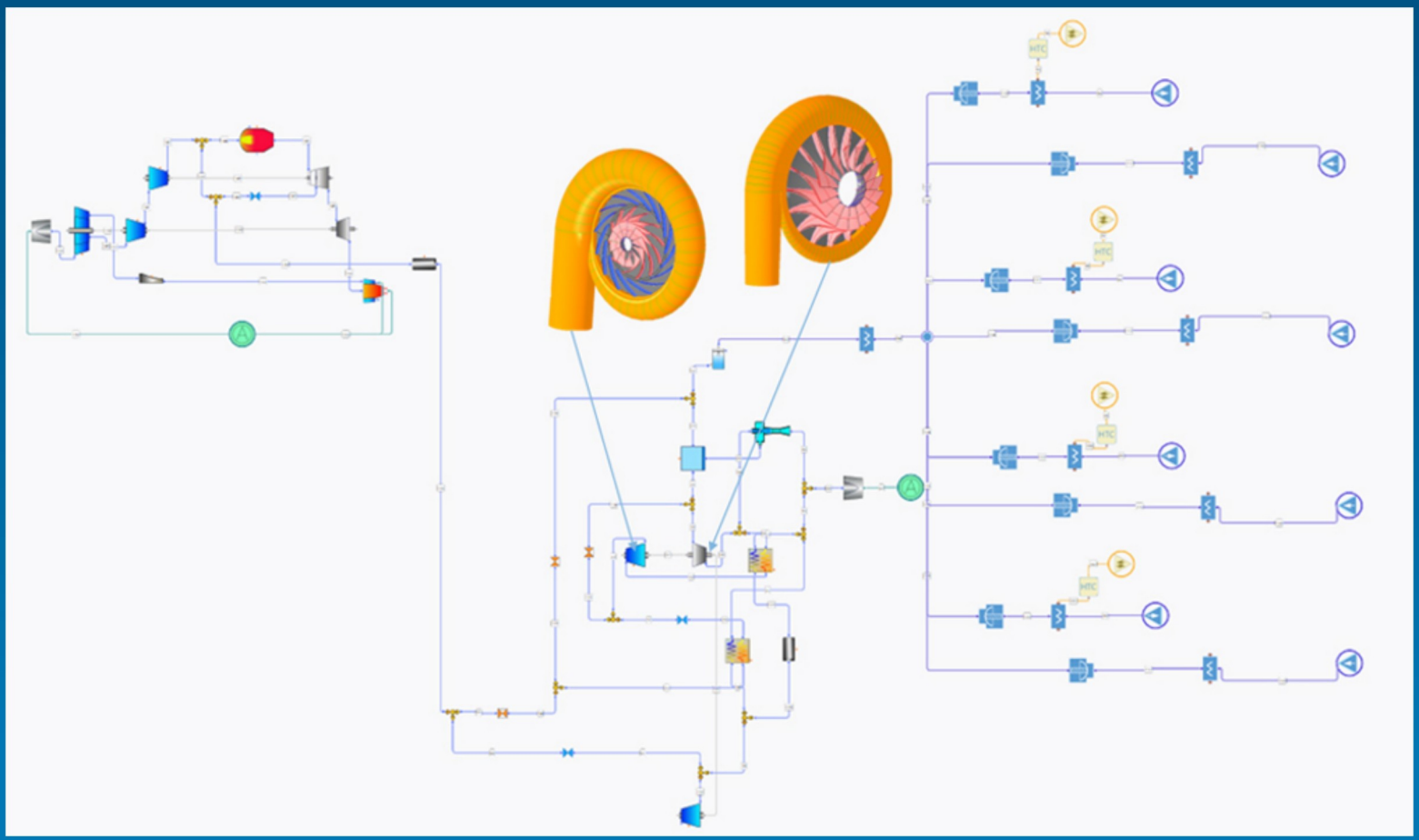
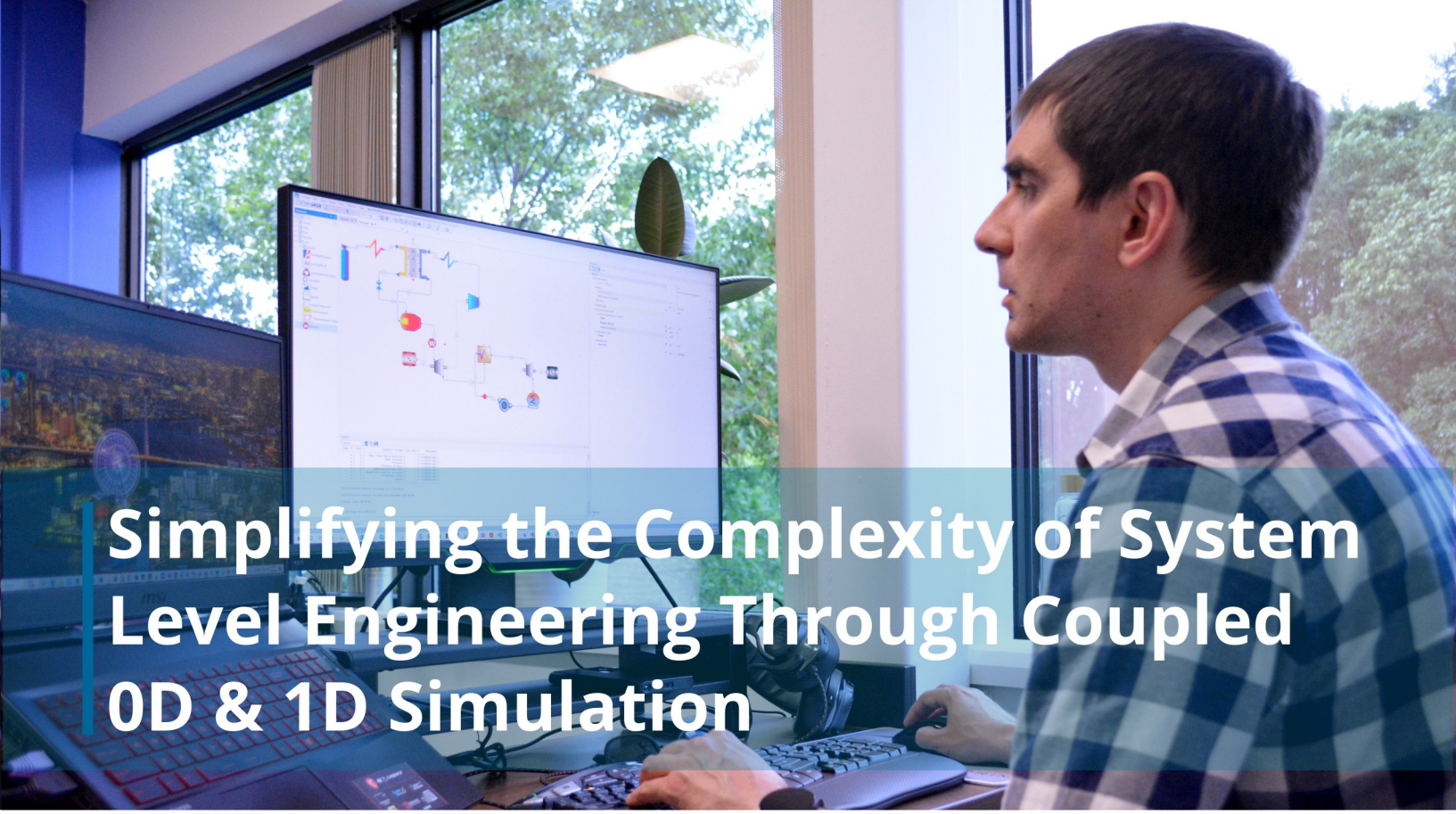
SoftInWay Incorporated

Holistic Multi-Fidelity Thermal-Fluid System Modeling & Analysis

AxSTREAM SYSTEM SIMULATION

Seamless Integration, Faster Result, Better Engineering

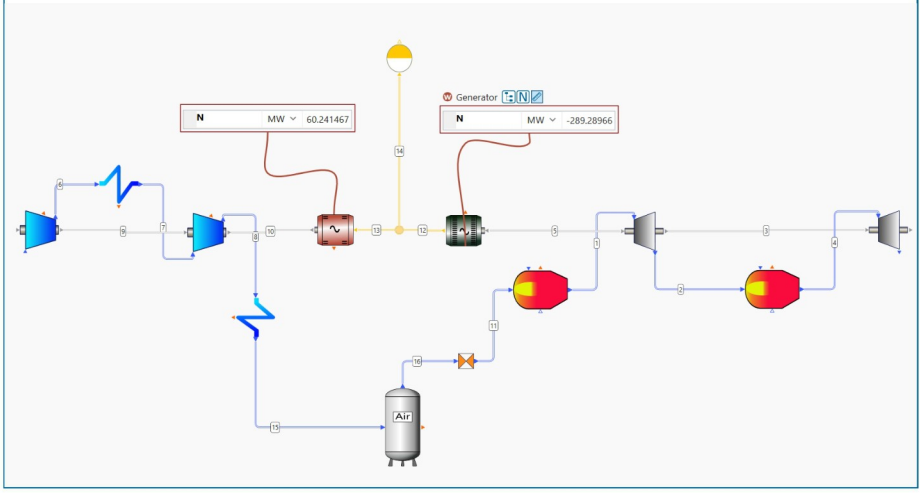




Simplifying the Complexity of System Level Engineering Through Coupled 0D & 1D Simulation

AxSTREAM System Simulation

Developed by engineers, for engineers, AxSTREAM System Simulation™ is a modeling software designed to integrate thermodynamic cycles and thermal-fluid networks within a single platform. Its flexible drag-and-drop component library allows users to design and analyze energy and propulsion systems in both steady-state and transient conditions.



How you can utilize AxSTREAM System Simulation:

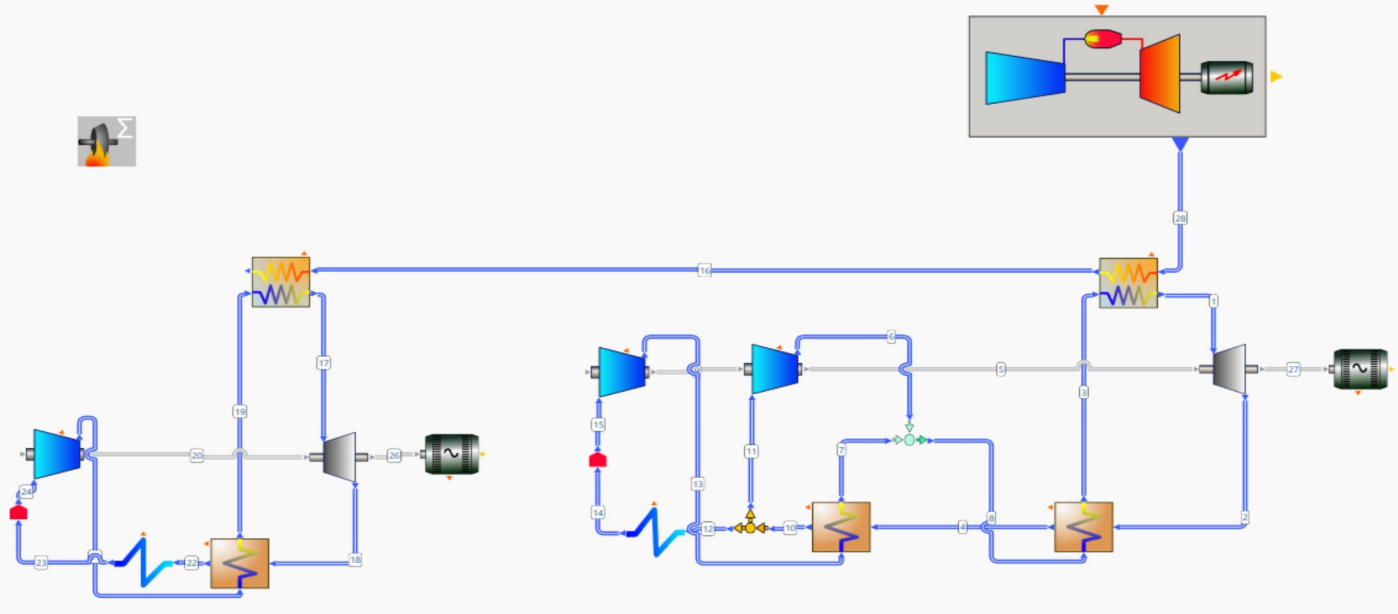
- Design, model, and explore new energy conversion systems including propulsion, HVAC, refrigeration, power generation, etc., as well as related auxiliary systems
- Evaluate different cycle architectures and analyze the performance of off-the-shelf products.
- Optimize existing equipment (including engines and power plants) accounting for all affected technologies in one interface.
- Run parametric studies to rapidly iterate and optimize new and existing technology for peak performance.

Transforming Product Development Through Advanced Simulation

Leverage AxSTREAM System Simulation to drive innovation without compromising on speed or quality

Overhaul your designs with AxSTREAM

- Run steady-state and transient calculations, enabling a more practical understanding of system performance under real-world conditions.
- Various fidelity levels are available, ranging from basic 0D to advanced 1D tubular heat exchangers and detailed components, enabling flexible modeling from simple pumps to complex piping configurations for comprehensive system analysis and optimization.
- Integrate system-level modeling with other software through co-simulation for a comprehensive and holistic design approach.
- Customize components and parameters throughout the system via scripting (Python, C#, etc.) and tables, empowering users to create their own control logic.



Virtual Testbench:

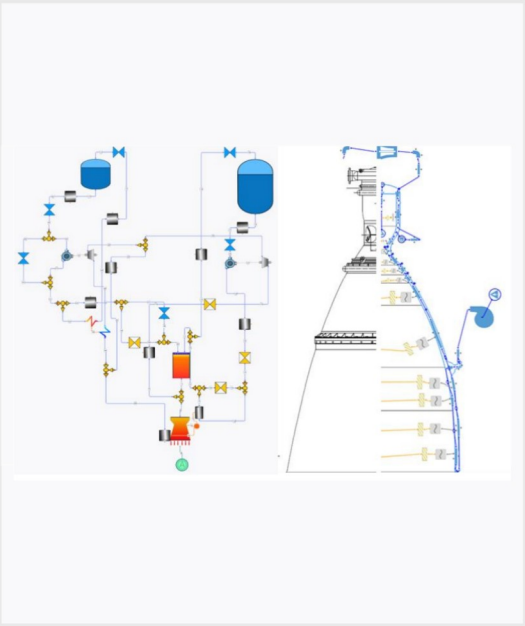
By empowering users to optimize their designs digitally with a seamless blend of steady-state and transient calculations, along with an extensive fluid library, AxSTREAM System Simulation serves as the ideal virtual testing ground for engineering teams, reducing the need for physical testing and unnecessary costs.

Digital Twin:

AxSTREAM System Simulation offers digital twin modeling capabilities by removing the interface and communication gaps between siloed software or sub-systems and teams through integrated 0D-1D reduced-order modeling of dependent multidisciplinary systems, eliminating challenges when multiple tools and models are required.

AxSTREAM System Simulation Use Cases:

Rocket Nozzle Cooling System Modeling



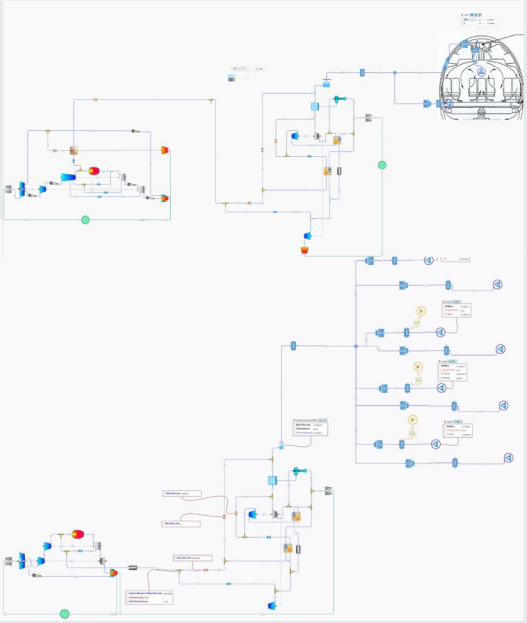
Objective: Model and optimize LRE's regeneratively cooled nozzle for modeling of complete propulsion and cooling system at full thrust and throttled conditions.

Challenge: Model wall temperature and heat transfer throughout nozzle cooling channels accounting for supercritical fluid properties and propellant phase change.

Solution: Coupling the 0D propulsion and 1D thermal-fluid systems into a single model allowed investigating and optimizing the rocket engine at different operating conditions.

Benefit: Accurately modeling the nozzle cooling system enabled precise boundary condition estimates for turbine design and detailed thermal and structural analysis of wall materials, enhancing overall system performance and reliability.

Integrated Environmental Control System



Objective: Develop and optimize an Environmental Control System (ECS) integrated with a mid-haul aircraft engine to determine the optimal bleed air conditions for maintaining cabin and cargo environmental standards.

Challenge: Analyze system operation across flight modes and altitudes to determine air extraction for comfortable cabin conditions, evaluating thrust, fuel consumption, efficiency, energy losses, pressure ranges, thermal loads, and air humidity.

Solution: Leverage a connected 0D-1D thermal-fluid network approach to assess system performance, evaluating thrust, fuel consumption, efficiency, and energy losses under various conditions.

Benefit: Precisely control cabin conditions and optimize the system in one software platform for improved performance and passenger comfort.

Gain a Competitive Edge With AxSTREAM System Simulation

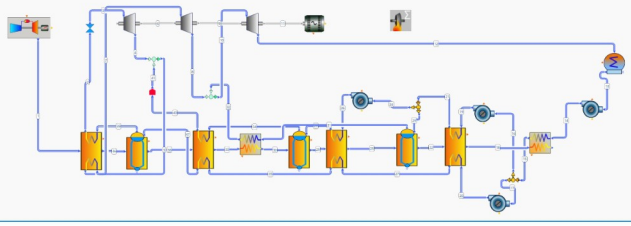
The AxSTREAM Advantage:

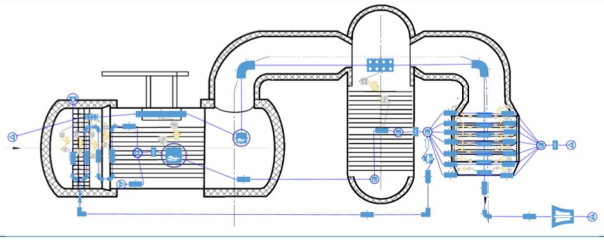
- Outstanding & intuitive interface makes learning and using easy.
- Embedded tools for parametric studies and optimization.
- Multidisciplinary program that can be used to model both turbomachinery and non-turbomachinery systems.
- Flexibility of problem formulation.
- Customization of components, fluids and materials.
- Account for component performances (including maps) or link to external tools for on-point performance predictions.
- Global technical support by more than 90 engineers.
- Constant updates containing new features and components evolve based on customer feature requests from our 750+ clients.

"AxSTREAM System Simulation is a fantastic tool for thermodynamic cycle modeling. It allows me to optimize efficiency by examining the effects of various inputs while ensuring compatibility between our thermal input and the power conversion system. A simple interface ensures I can add or modify existing components easily and helps me to ensure the necessary components fall within manufacturers capabilities. The included fluid library makes it simple to pick up the software, without the need for integrations and plugins. The use of custom variables helps to easily track all the relevant outputs in one place, and the multi-run tools make it easy to examine individual and combined effects of multiple inputs on the cycle, to maximize cycle efficiency."

Skyler Allen
Mechanical Engineer
Flibe Energy Inc.

Maximize your scripting capabilities with AxSTREAM System Simulation. Leverage C#, Python, and more alongside tabular parameters for each component, combining the power of custom scripts with an intuitive graphic user interface, enhancing flexibility and ease of use.

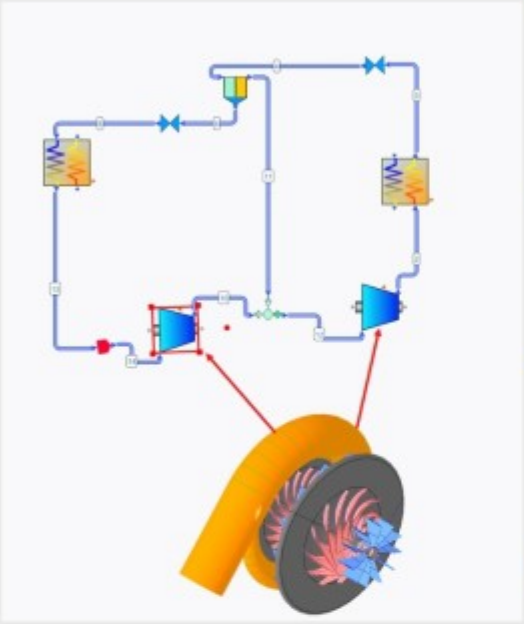




Skip the time-intensive 3D design process and explore a wide range of 1D designs with AxSTREAM System Simulation. By leveraging these features, engineers can achieve faster design iterations, reduce development costs, and accelerate time-to-market.

AxSTREAM System Simulation Use Cases:

Ground Source Heat Pump Modeling



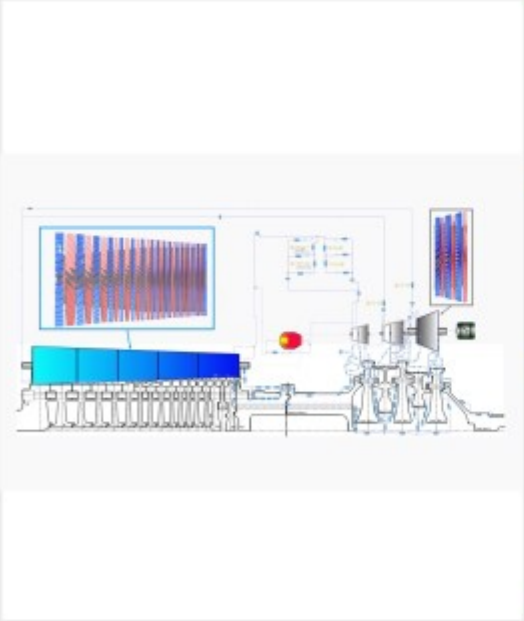
Objective: Develop a detailed model of a ground source heat pump system to optimize heat transfer coefficients during refrigerant phase transitions across various operational modes.

Challenge: Model thermal-hydraulic behavior to accurately estimate heat transfer coefficients affected by refrigerant phase changes.

Solution: Utilize AxSTREAM System Simulation for precise thermal-hydraulic modeling, refining calculations and geometrical parameters to ensure accurate heat exchanger performance.

Benefit: By accurately discretizing heat exchangers and integrating pump and compressor characteristics, the heat pump model achieves optimal fluid-thermal performance and hydraulic efficiency for diverse applications.

Gas Turbine Secondary Cooling Flow Path Modeling



Objective: Estimate pressure and velocity distributions, analyze swirl momentums, and evaluate heat transfer in complex secondary flow paths under specified boundary conditions.

Challenge: Design and verify complex secondary flow paths, considering flow resistance, pressure losses, and heat transfer coefficients.

Solution: Employ a holistic approach integrating compressor and turbine design, stress prediction, and thermodynamic cycle modeling with automated iteration for optimizing cooling flow paths and thermal stress management across operational regimes.

Benefit: Accurate domain discretization predicts flow path pressures, temperatures, and velocities, while built-in criteria correlate heat transfer coefficients for turbine operational efficiency and performance, saving time and reducing development cost.

Understanding Dynamic System Behavior Through Advanced Calculations

Take your machine performance to the next level with AxSTREAM System Simulation's transient calculations

Transient Calculations

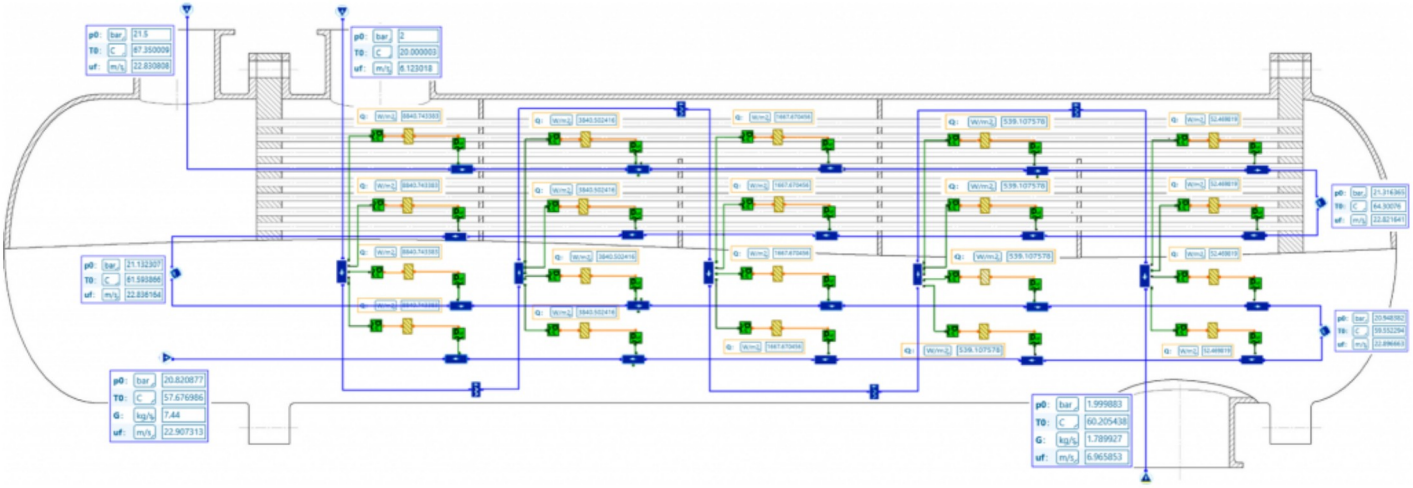
AxSTREAM System Simulation provides comprehensive insights into the dynamic responses of turbomachinery, energy conversion, and propulsion technology systems.

Engineers leverage advanced full transient solvers to assess real-time system behavior, crucial for design, safety, and stability in applications ranging from rocket engines and small modular reactors (SMRs) to energy storage systems and cooled gas turbines.

The software supports detailed studies on system responses to external inputs, facilitating optimization of performance and operational efficiency across diverse applications.

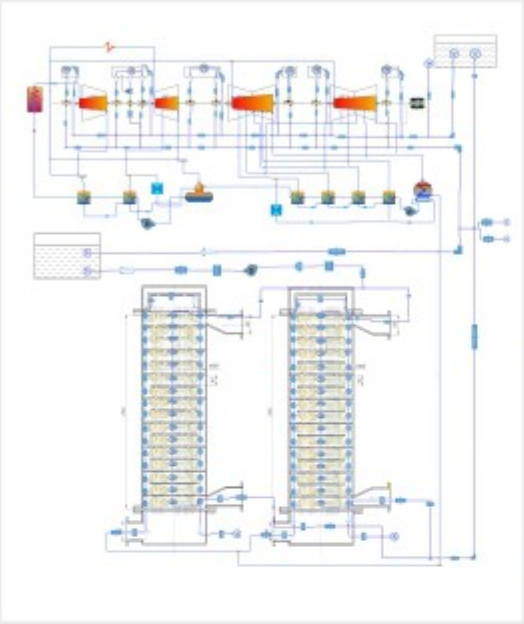
"For the past four years, over 250 students at ECPI University have benefited from the AxSTREAM System Simulation software to deepen their understanding of basic thermodynamic cycles, including Rankine, Refrigeration, and Brayton cycles. They learn how to create combined cycles to enhance overall system efficiency and performance. AxSTREAM System Simulation provides students with hands-on experience assembling thermal and fluid equipment components, such as pumps, turbines, compressors, and heat exchangers, into operating systems. They can then observe the system's behavior and see how changes to the system's design, such as boiler temperature or pump pressure, affect its overall performance."

Dr. Bryan Lewis
Adjunct Faculty
ECPI University



AxSTREAM System Simulation Use Cases:

Steam Turbine Lubrication System Modeling



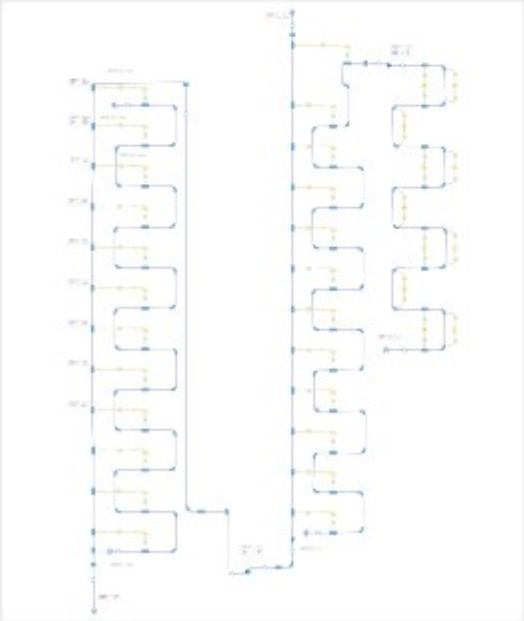
Objective: Select equipment which will provide the necessary mass flow rate and oil cooling requirements. Accurately design an oil supply pipeline system in AxSTREAM System Simulation.

Challenge: Determine oil flow rates for thrust, journal bearings, and cooling while considering geometric and operational constraints.

Solution: Leverage AxSTREAM System Simulation to model and optimize the oil supply system, incorporating pump characteristics and heat exchanger properties for accurate off-design condition simulations.

Benefit: By integrating pump specifications and conducting detailed analyses, the model accurately predicts temperature drops and hydraulic resistance, facilitating rapid design iterations and enhancing system reliability and performance.

Industrial Refrigerator Modeling

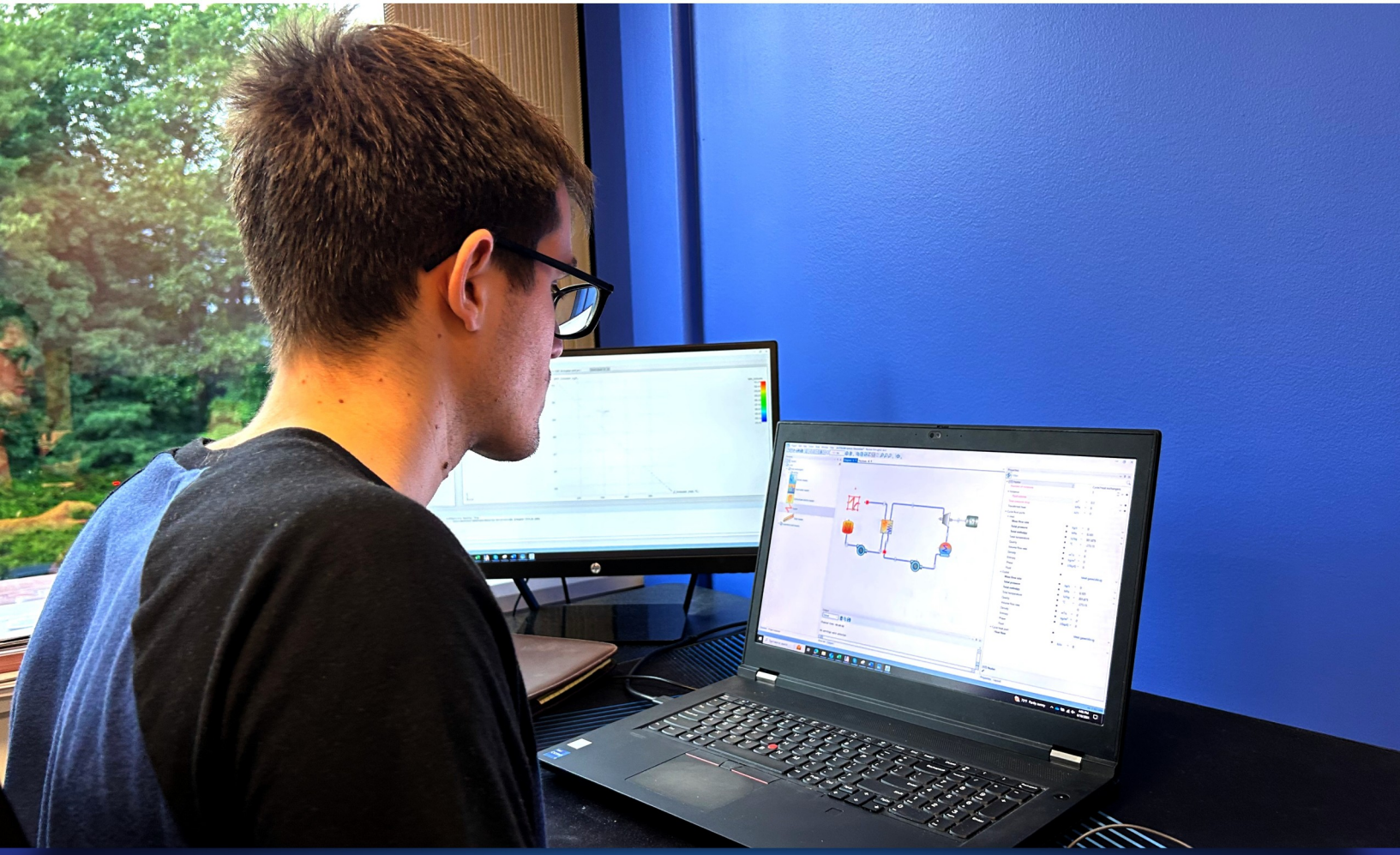


Objective: Develop and validate a refrigerator system capable of efficient operation across all modes, integrating pump and compressor selections.

Challenge: Perform detailed thermal and hydraulic calculations to accurately model heat exchangers and manage heat transfer coefficient errors during refrigerant phase transitions and transport network heat leakage

Solution: Employ AxSTREAM System Simulation for refined domain discretization of heat exchangers and comprehensive analysis of thermal elements and heat gains in the system.

Benefit: By integrating pump and compressor characteristics, the model accurately predicts heat transfer coefficients and hydraulic resistance, ensuring optimal refrigerator performance and reliability under varying operational conditions.



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