SoftInWay
Incorporated

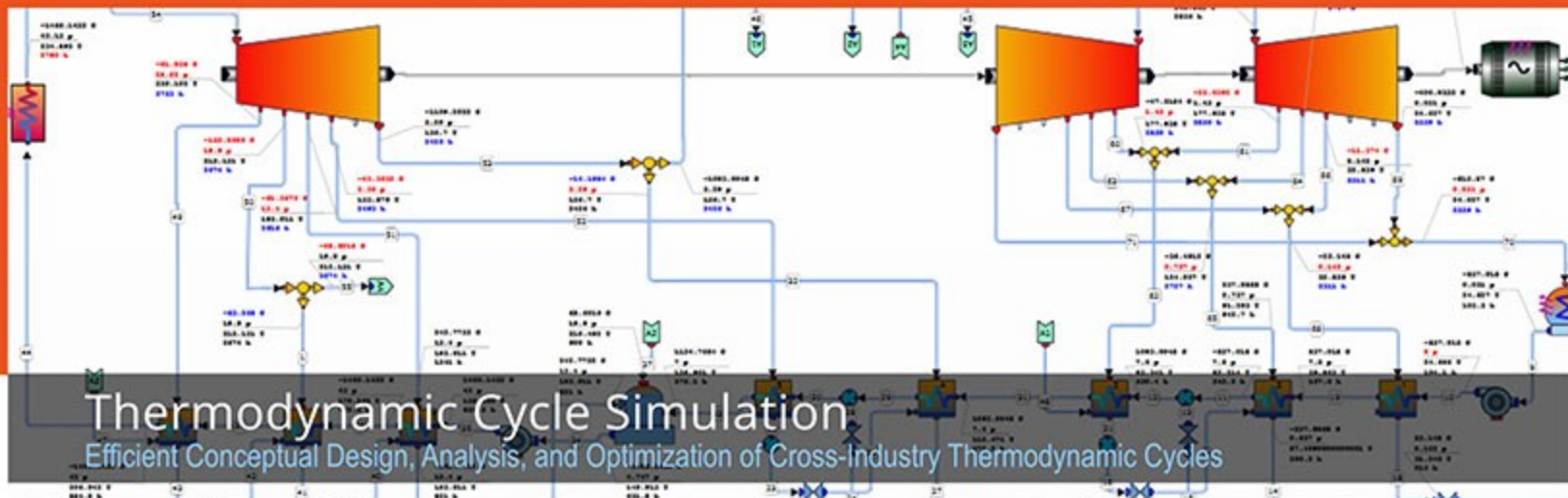# Turbomachinery Mastered
Design and analysis of turbomachinery

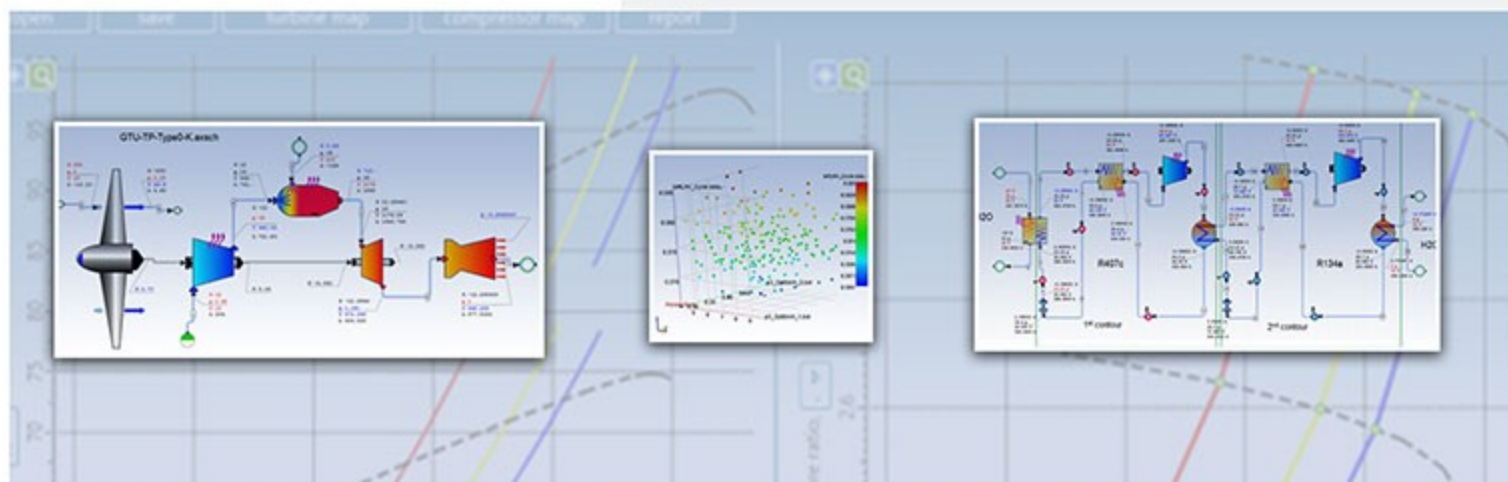# AxCYCLE™

design. analyze. optimize.

Designed for the thermodynamic simulation and heat balance calculations of heat production, refrigeration, propulsion and electric energy cycles, the AxCYCLE™ software platform allows users to design, analyze and optimize thermodynamic systems quickly and efficiently for design and off-design conditions.

As a conceptual tool, AxCYCLE™ uses only the basic thermodynamic parameters of the components such as pressure, enthalpy, temperature, fluid quality and basic performance parameters such as efficiency and turbine constant. No mechanical or geometric data is required!

AxCYCLE™ is the perfect software tool to use in either the conceptual design phase of a cycle or for the analysis of existing cycles. Its integration with the AxSTREAM® software platform makes design, analysis, and optimization more streamlined for the reduction of iteration time, human error, and the elimination of software incompatibilities.

The platform features an outstanding and intuitive interface, drag and drop simplicity with an embedded components library for turbomachines, heat exchangers, separation & mixing elements, generators, combustors, engines, as well as auxiliary elements. An infinite number of cycles are possible.
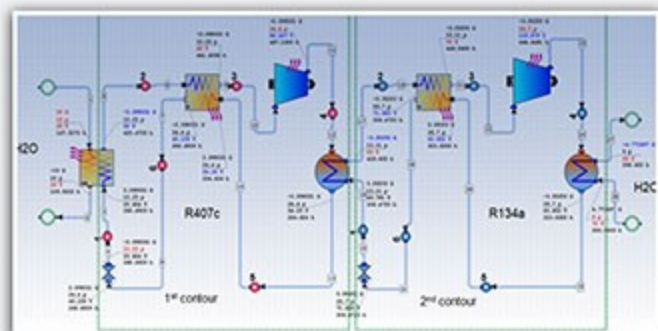
Easily create and optimize thermodynamic systems in a single software platform

AxCYCLE™ Features and Cycles

Features

- Simulate numerous types of cycles.

- Create cycle diagrams through our component library. Each component has connection points for fluid flow, thermal, electrical, and mechanical ports

- Flexible cycle creation using embedded component

- Run heat balance modeling simulations with only a small subset of component parameters.

- Flexible cycle simulations using a minimal amount of known data

- Perform parametric studies and optimizations as well as study cycle off-design performanc

- Calculate and compare P-H and T-S diagrams of cycle processes.

- Estimate power plant equipment cost and conduct investment analysis of plant construction.

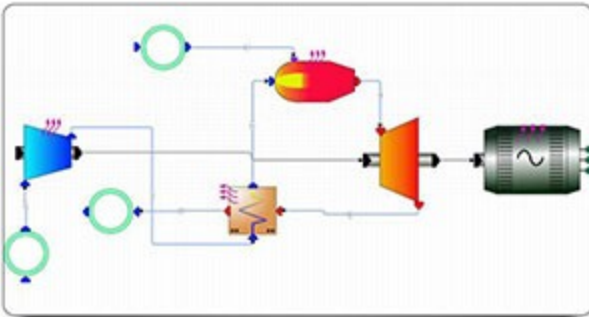- Compatible with batch mode enabling easy integration into automated workflows.

Simulate numerous types of cycles

Gas

Steam

ORC & sCO$_2$

Fuel Cells

Combined

Waste Heat Recovery

Refrigeration

Rocket
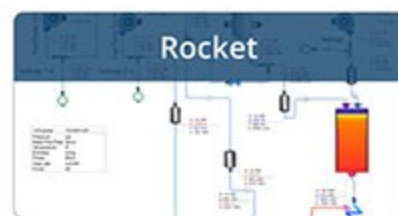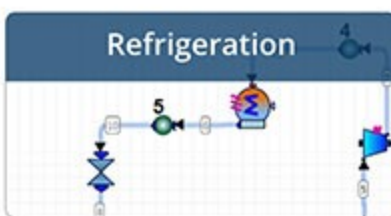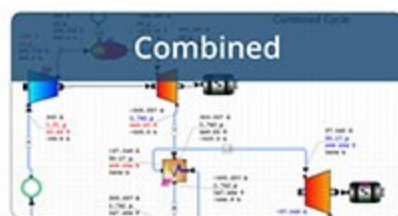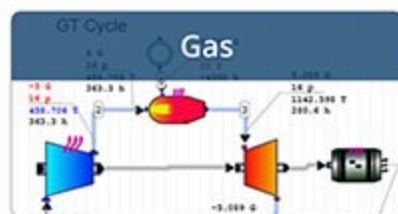
AxCYCLE™ Applications

Gas Turbines Cycles

AxCYCLE™ allows users to analyze thermodynamic processes of the gas turbine plant. AxCYCLE™ provides a library of 400+ existing gas engines with OEM performance data. It can be used "off-the-shelf" to simulate and combine different combined cycles. Library users can also create any gas turbine they desire with a customized compressor, combustion chamber, and turbine.

Steam Cycles

AxCYCLE™ lets you simulate steam cycles of arbitrary configurations. Thermal power plants have advantages that distinguish them from power plants that use a gaseous working medium. The steam cycle is a practical one; it is the basis of virtually all steam power plants and hence, electricity generation. AxCYCLE™ provides steam cycle simulations for fossil and nuclear power plants.
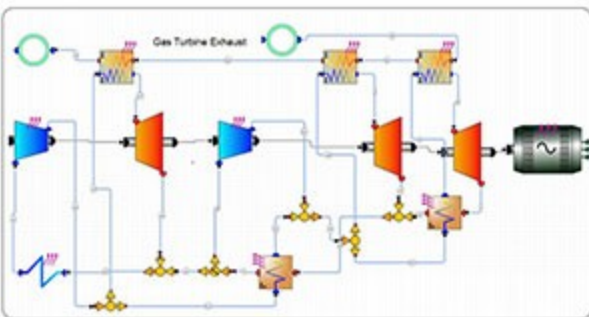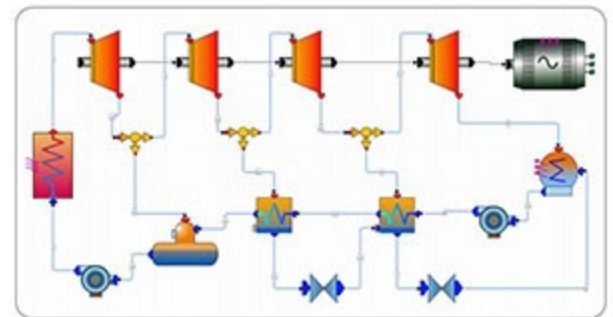
Supercritical CO$_2$ & Organic Rankine Cycles

Supercritical fluid is fluid over its critical temperature and pressure that exhibits good solvent power. AxCYCLE™ lets you model every phase of the design for turbines and compressors for Supercritical CO$_2$ cycles. Organic Rankine Cycles (ORC) apply the principles of steam Rankine cycles, but use organic working fluids with low boiling points to recover heat from lower temperature heat sources. AxCYCLE™ allows you to simulate ORC cycles for any configuration and provides NIST refrigerants and fluids.

## Fuel Cell Cycles

The use of hydrogen in fuel cells is extremely effective because it allows the chemical energy of the fuel to be converted directly into useful electrical energy, avoiding the high-temperature combustion process. AxCYCLE™ enables you to simulate complete cycles with fuel cells and analyze the effect of changes in parameters on the fuel cell system and associated components.

AxCYCLE™ Applications
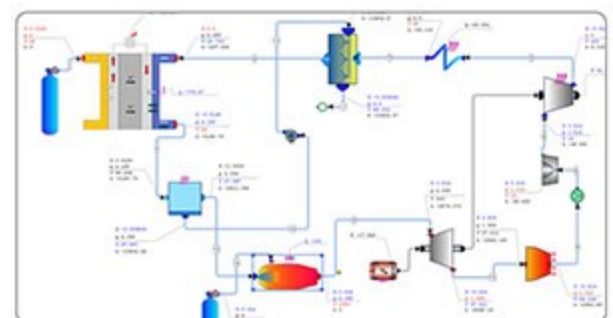
Combined

AxCYCLE™ enables you to model phases of electrical and thermal power generation with different types of combined cycles. These include gas and steam turbine combined cycles, which are successfully utilized in hundreds of power plants worldwide, and also new cycles, such as gas and sCO_2 combined cycles, gas and ORC combined cycles, steam and ORC cycles, and more.
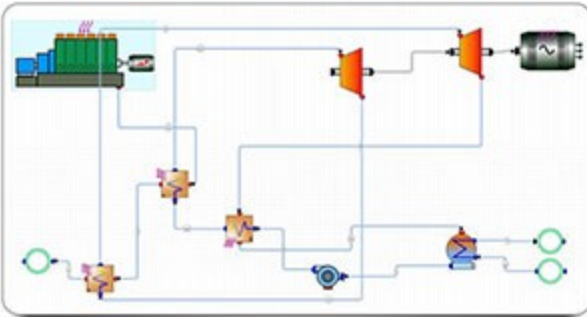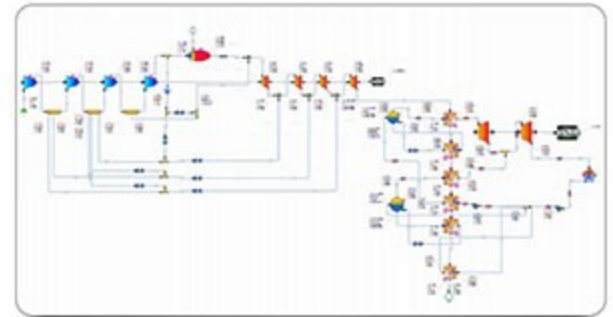

Waste Heat Recovery Cycles

AxCYCLE™ is not limited in terms of number of cycle loops or fluids that can be used within a single project. This, along with the unnecessity of mechanical/geometric input data as the multitude of media to work with make AxCYCLE™ the perfect tool for innovation like waste heat recovery in different industries.

Refrigeration Cycles

AxCYCLE™ is not just for power generation or propulsion, but also for other types of cycles including refrigeration/heat pumps. A wide selection of appropriate fluids are available with thermodynamic properties taken directly from the NIST RefProp directly from a variety of fluid databases.
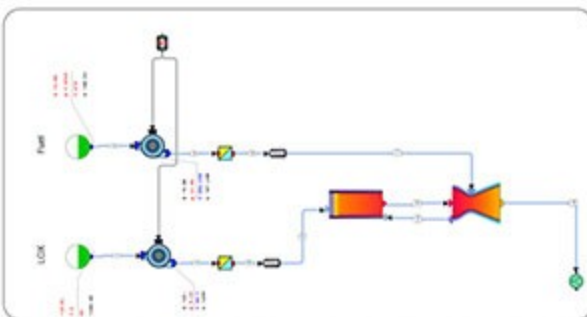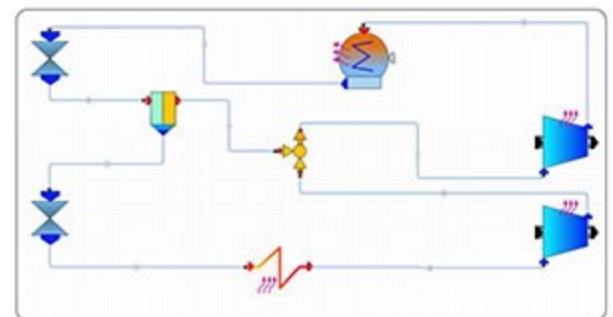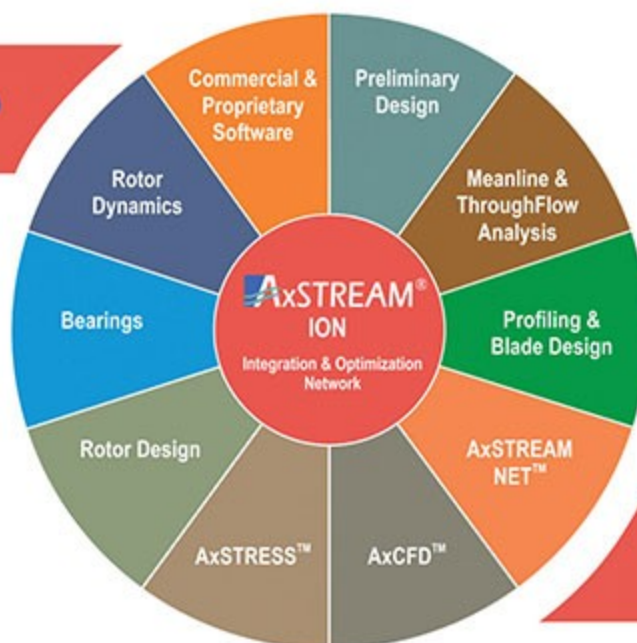

Rocket Cycles

AxCYCLE™ allows you to quickly and accurately design new and redesign existing rocket engine cycles. Through the software, users can create exact liquid propulsion systems and analyze them at design and off-design conditions. Additionally, AxCYCLE™ also integrates with different fluid libraries such as CEA, NIST Refprop, Coolprop, and many others.

AxCYCLE™ and AxSTREAM® Integrated

Import design criteria from AxCYCLE™

What if you could design, analyse and optimize your turbomachinery 50% faster and with better accuracy?

AxCYCLE™ and AxSTREAM® can exchange project data and performance maps quickly and intuitively.

Import geometry from AxSLICE

When AxSTREAM® opens an AxCYCLE™ file, it automatically builds a project for preliminary design.

AxCYCLE™ Economics

The AxCYCLE™ Economics Module provides power plant equipment cost estimation as well as investment analysis of plant construction. It includes means for TCI (Total Capital Investment), NPV (Net Present Value), LCOE (Levelized Cost of Electricity), Cash Flow, Payback Period and for other parameters definition. The module features opportunities for user-defined data use, the incorporation of the user's models for equipment cost estimation, and comparisons of cash flow charts with alternative projects.

CASE

CASE is used to calculate series of user-defined cases based on an unlimited number of variables and objectives. It is the perfect tool to calculate different load points when not only operational parameters are changed but some cycle branches may be closed and opened again. Additionally, it is spreadsheet-friendly for improved import & export user experience.

PLAN

PLAN is a multivariable engine powered by a DoE (Design of Experiment) engine. The DoE engine itself selects points (a set of values for up to 20 simultaneous variables and an unlimited number of functions), in an optimized way, to minimized the number of solver runs. The obtained results are used to build "response surfaces" that are used asabstract models for optimization.

Fluids

AxCYCLE™ features several fluid libraries including steam, air, and natural gas, as well as NIST REFPROP models for SCO_2, refrigerants, ethanol, mixtures, and more. Additionally, custom fluids came be created easily within AxCYCLE™ and combustion products can be user-defined or calculated automatically based on fuel composition and air excess factor.

QUEST

QUEST enables AxCYCLE™ users to study quasi-random combinations of parameter values within user-defined ranges. Optimization is performed based on a created design space to filter, compare, and select the optimum combination for the given application.

Map

Multi-run tool used to run a series of calculations for up to 2 variables. MAP is a very effective tool to study the influence of operational parameters on cycle performance. It is also the ultimate tool to calculate cycle performance curves.

AxCYCLE™ Solver

AxCYCLE™ provides the design and off-design steady state heat balance calculation for thermodynamic cycles.

AxSTREAM® Training Workshops:

SoftInWay delivers software tools and industry training that enable you and your organization to be more effective. With our extensive curriculum from AxSTREAM® and AxCYCLE™ hands-on workshops to Waste Heat Recovery and Liquid Rocket Engine design courses, we cover the diverse training needs of our global turbomachinery customers through:

- Traditional classroom training
- Online courses
- Corporate learning programs

AxSTREAM® 3.9 Software Platform New Modules: AxSTREAM.ION™

Engineering Services

Education
Classroom Workshops
Online Courses
Self-Paced Video Courses

SoftInWay, Inc. is a global R&D engineering company specializing in the development of efficient turbomachinery components and systems through its integrated and automated software platform, AxSTREAM® for all steps of the turbomachinery development process (including complete 3D design, thermodynamic cycles, rotor dynamics, and secondary flow and cooling system simulation). SoftInWay also offers a number of engineering services and educational courses, available both online and in a classroom-style setting

Being an ISO 9001:2015 and AS9100:2016 certified company, SoftInWay is committed to providing its customers with products and services that meet international quality standards.

With offices around the globe, SoftInWay supports more than 450 companies worldwide, and works closely with universities, research laboratories, and government organizations.

Industries Served:

Power Generation

Oil & Gas

Aerospace

Clean Technology

Government & Defense

Appliances & Medical Devices

HVAC & Refrigeration

Automotive

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