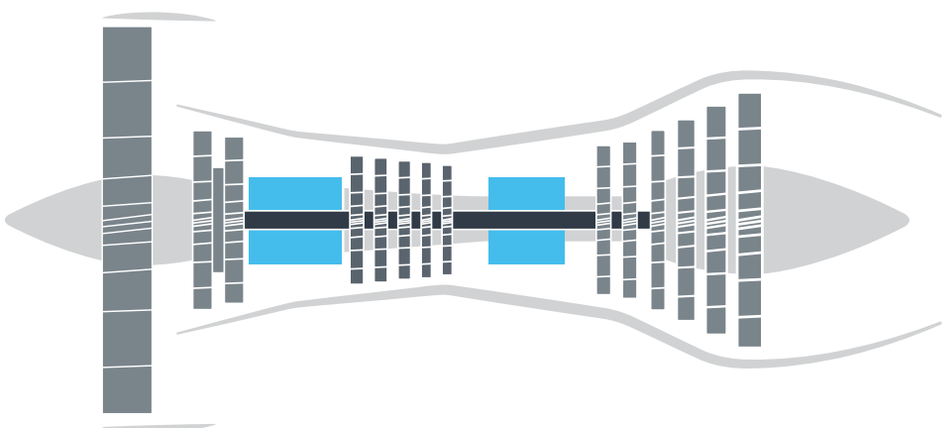
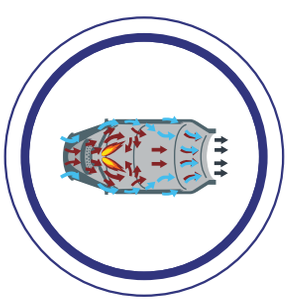
FLOWNEX®

SIMULATION ENVIRONMENT

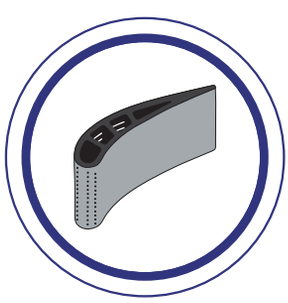
Bringing nuclear quality and standards
to system simulation.



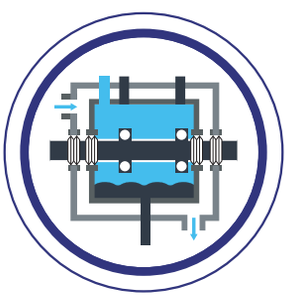
Secondary
Flow



Combustion
Chamber



Blade
Cooling



Lubrication
Systems

SECONDARY & COOLANT FLOW

Flownex® includes a comprehensive rotating component library for analysing the secondary air system of a gas turbine engine. This enables engineers to quantify the bleed air consumption and flow distribution through the entire system. Furthermore, coupling Flownex® with Ansys Mechanical enables engineers to perform detailed thermal studies of critical rotating components. Flownex® includes:

- Real gas models
- Windage power calculation
- Choking calculations
- User-defined HTCs

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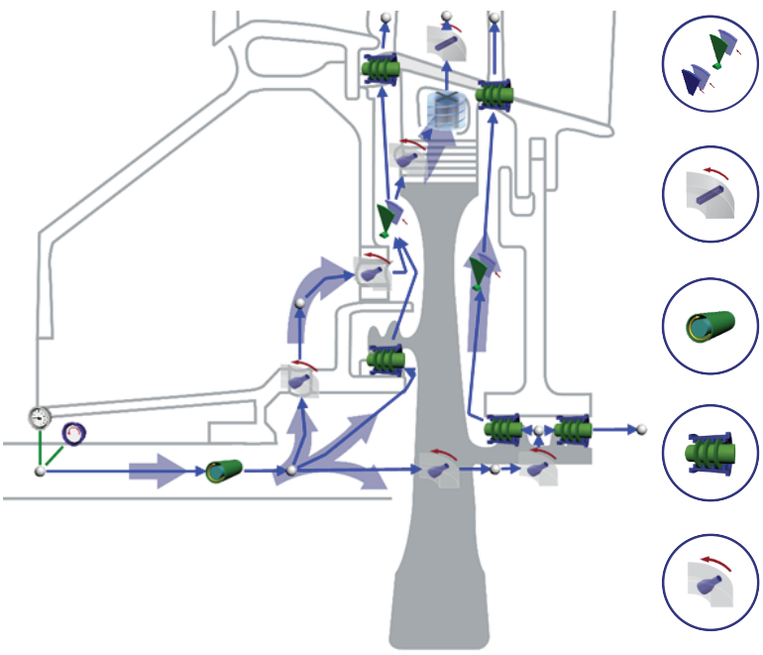
WEBINAR

Rapid Design of Cooling Flow Paths for Turbomachinery

FLOWNEX® SIMULATION ENVIRONMENT Ansys

MECHANICAL COUPLING

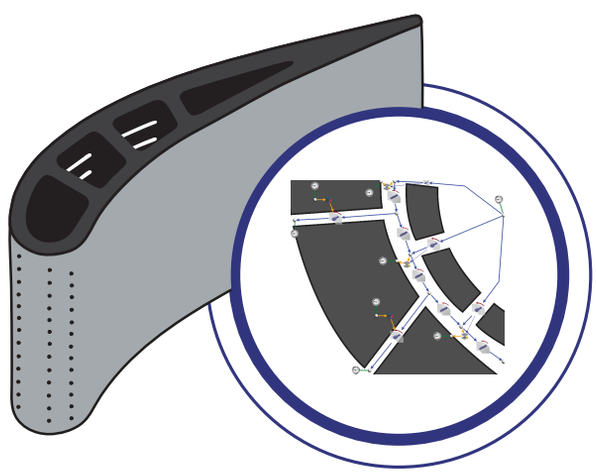
SECONDARY FLOW



- **Rotor-stator and rotor-rotor cavity**
  incremented moment balance, windage calculations, graphical cavity editor
- **Rotating nozzle**
  detailed C_d calculation considering inlet geometry, length, incidence angle, etc.
- **Rotating annular gap**
  incremented friction calculations, swirl calculations
- **Labyrinth seal**
  incremented pressure drop, large number of geometry options
- **Rotating channel**
  incremented friction calculations, designed for any orientation (radial, axial, combined)

BLADE COOLING

By coupling 1D flow Flownex® models with 3D heat transfer models in ANSYS Mechanical or CFX, a detailed turbine blade cooling simulation can be conducted. Flownex® contains industry standard pressure drop and heat transfer correlations for typical turbine blade features such as turbulator strips and pedestals. This allows designers to rapidly see the effects of their design changes on the maximum blade temperatures and cooling air flow rate.



LUBRICATION SYSTEM

The primary use of Flownex® in lubrication systems is used to determine optimum drain line sizes given the limited space inside the engine. This requires two-phase pressure drop calculations in lines with oil-air mixtures. In parallel with this engineers can determine whether or not scavenge pumps are required for fluid transportation in the drain lines and, if so, what the pumping requirement will be.

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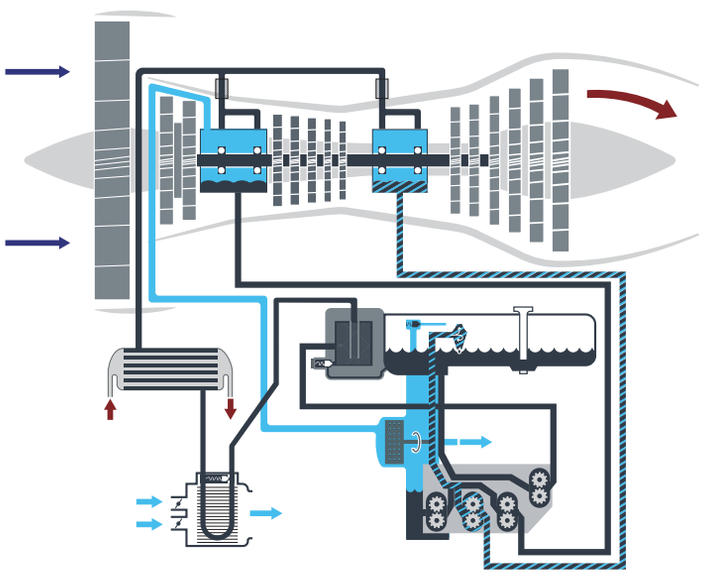
Lubrication System Modeling



- **Pipe**
  calculates two-phase pressure drop of oil-air mixtures

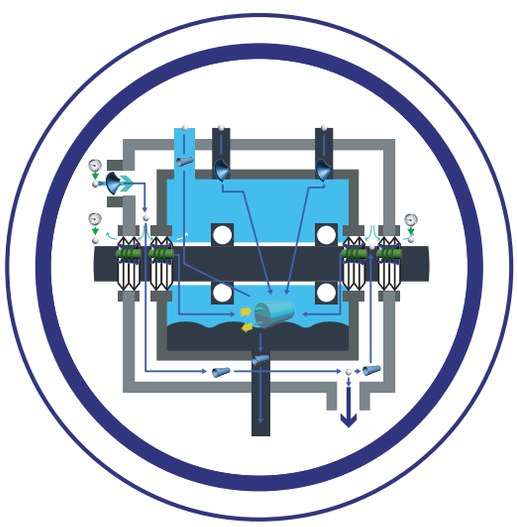
- **Nozzle**
  detailed C_d calculation considering inlet geometry, length, etc.

- **Positive displacement pump**
  calculations for viscosity scaling, power usage and NPSH

- **Two phase tank**
  calculate level in bearing chamber and couple pressures in oil and air streams

- **Finned tube heat exchanger**
  custom correlations and incremented heat transfer

- **Plate heat exchanger**
  custom correlations and incremented heat transfer



COMBUSTION CHAMBER

Preliminary combustor design requires that an extensive number of geometrical and operational conditions be evaluated and compared. Especially during this phase Flownex® is an essential tool for combustor design engineers as it accurately captures important parameters such as the mass flow rate distribution through air admission holes, associated pressure losses as well as liner wall temperatures.

Networks can be easily configured and solve within a few seconds. This result in substantial development cost savings because of the reduction in the number of detailed 3D simulations and rig tests required. A further advantage is the ability to use the Flownex® results as boundary conditions to subsequent localized 3D models.

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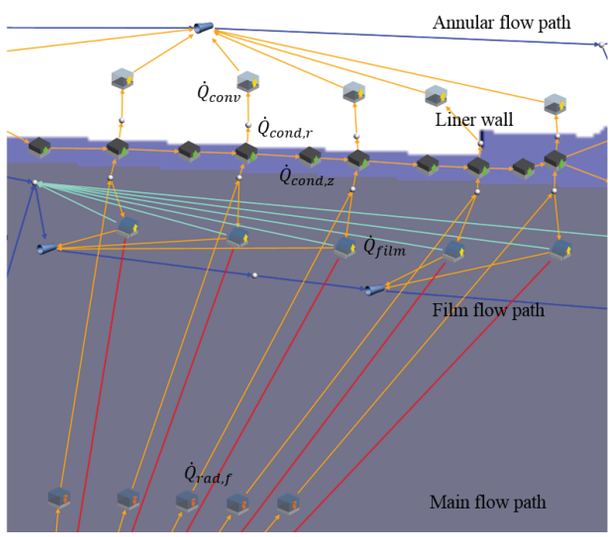
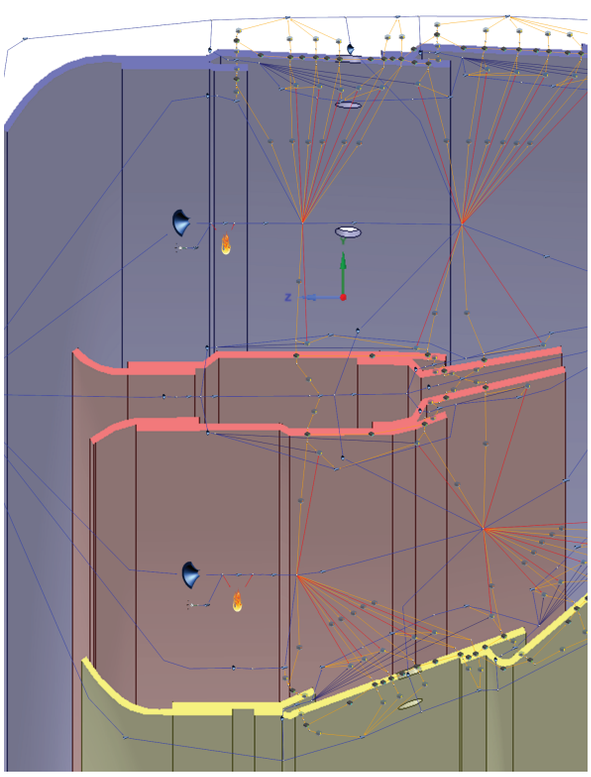
WEBINAR

Rapid Combustor Modeling in a 1D Fllow Network Tool





- **Radiation**
  surface to surface and fluid to surface options available
- **Film convection**
  industry standard correlations with built-in film accumulation effects
- **Convection**
  annular convection on outer side of liner wall
- **Nozzle**
  detailed C_d calculation considering inlet geometry, length, incidence angle, etc.
- **Adiabatic flame**
  flame temperature and combustion products calculation
- **Conduction**
  radial and axial conduction

EXPERIMENTAL COMPARISON

A comparison to experimental data published by NASA shows good agreement between the Flownex® results and real-world temperatures of the liner wall for a wide range of operating conditions. The full report was presented at the 2016 ASME turbo expo.

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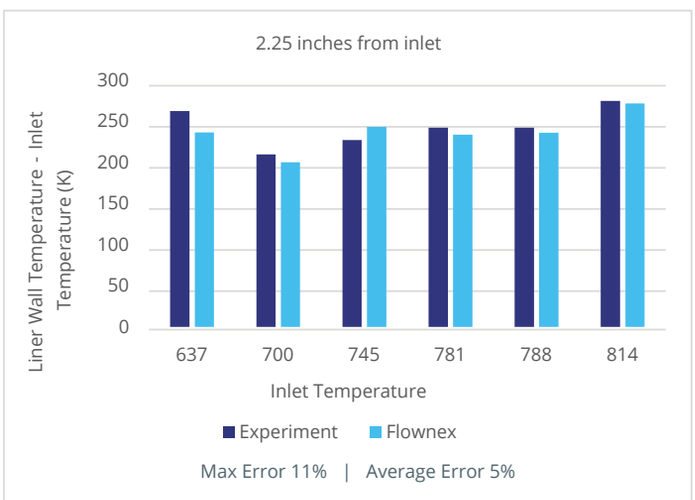
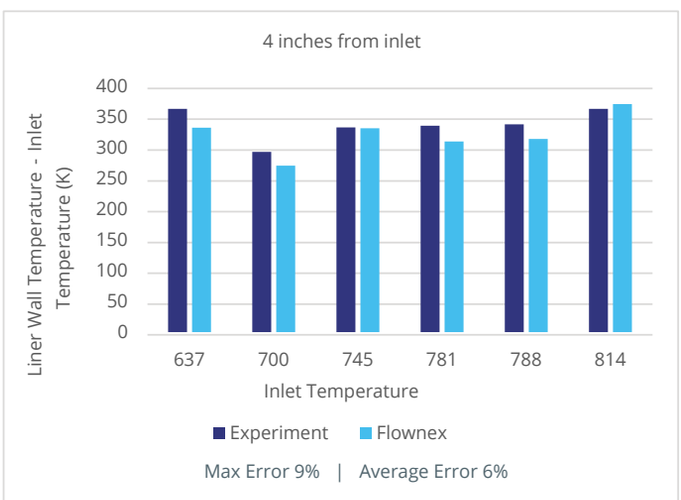
WHITE PAPER

Rapid Preliminary Combustor Design

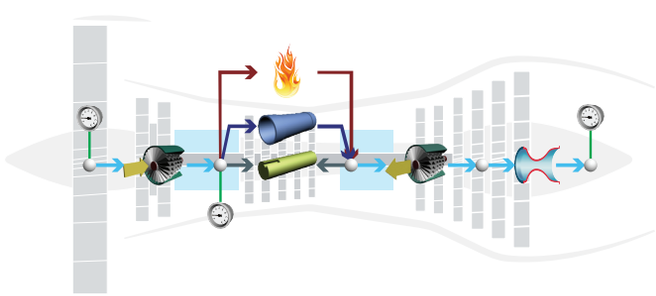




SOLUTION TIME < 3 SECONDS WITH A MAXIMUM ERROR < 11%

INTEGRATED SYSTEM ANALYSIS

Flownex® allows engineers to couple all turbine models (combustor, secondary flow, and lubrication) with the main flow path to understand the performance of the entire engine.



- **Compressor**
  0-D map with variable speed and surge margin calculations
- **Turbine**
  0-D map with variable speed and variable efficiency.
- **Shaft**
  power matching of shafts with connected turbines and compressors
- **Adiabatic flame**
  flame temperature and combustion products calculation
- **Exit thrust nozzle**
  thrust calculation using momentum conservation for real gases

SUPERCRITICAL CO2

ANALYSIS
- Performance assessment
- Modification assessment
- Root cause failure analysis

DESIGN
- System sizing
- Component sizing
- Determining operating ranges
- Calculate flow, temperature, pressure, power consumption, etc. at different operating conditions
- Evaluate different control philosophies

OPTIMISATION
- Heat exchanger length optimization
- Efficiency optimization at different design points

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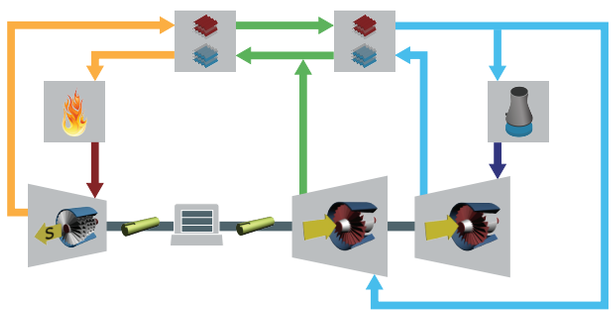
BROCHURE



HYDROGEN

ANALYSIS
- Hydrogen production, filling, transport and storage
- Performance assessment of different fuel cell technologies with auxiliary components
- Transient behaviour comparison of different cycle layouts
- Export reduced order models of integrated system

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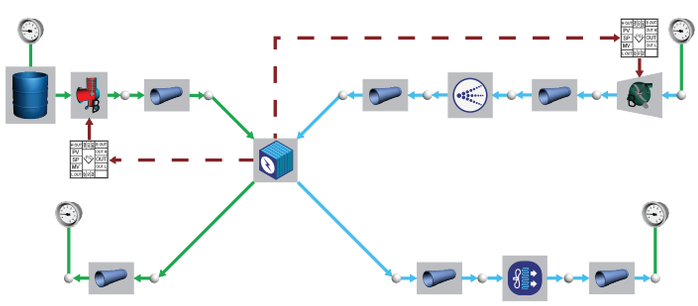
BROCHURE

DESIGN
- Component sizing
- Determine operating ranges
- Auxiliary cycle performance requirements
- Coupling with Ansys Fluent for detailed 3D geometry of cells



OPTIMISATION
- System component optimisation
- Integrated system behaviour

NUCLEAR & SMR

ANALYSIS
- Integrated reactor response using point kinetic neutronics
- Plant response simulations
- Start-up, shut-down and load following simulations
- Accident scenario investigations (e.g. LOCA)
- Control logic verification simulations

DESIGN
- Technical feasibility studies
- Valve, pump & pipe sizing
- Balance of plant sizing

OPTIMISATION
- Control system optimisation
- Auxiliary power consumption optimisation
- Automated parametric studies

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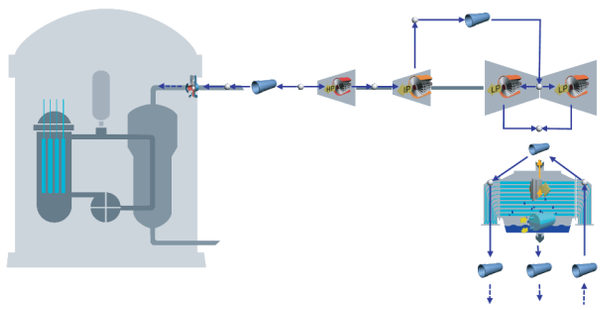

SPACEFLIGHT

ANALYSIS
- Fast transient simulations
- Analysis of system response
- Oxygen and fuel rate requirement
- Material temperature evaluation
- Point of failure root cause analysis

DESIGN
- System component sizing
- System thermodynamics and performance
- Heat transfer interfaces and limiting temperatures
- Control system philosophy

OPTIMISATION
- Piping geometry and configuration
- Oxygen to fuel ratio
- Cooling strategies
- Insulation material
- Nozzle geometry

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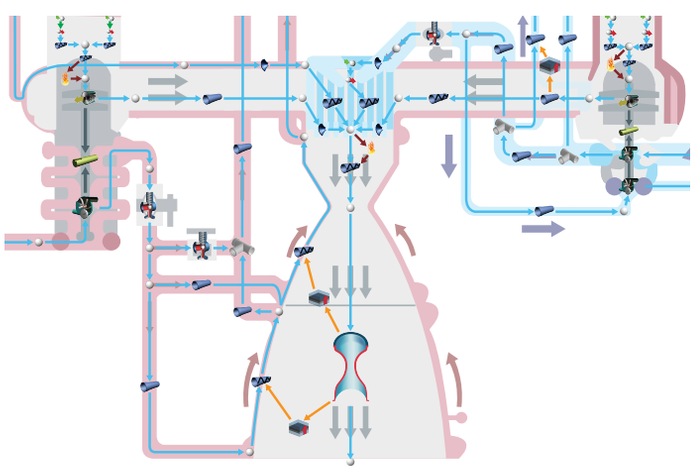

REQUEST A DEMO

See our software in action. Request a demo to determine how Flownex® can work for you.

LUFTHANSA TECHNIK AG

Stefan Kuntzagk

Performance & Design Engineer

"Flownex is able to accurately predict flow and heat transfer in secondary air systems, whilst reducing model setup and execution time substantially compared with 3D CFD."