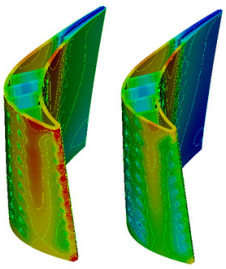
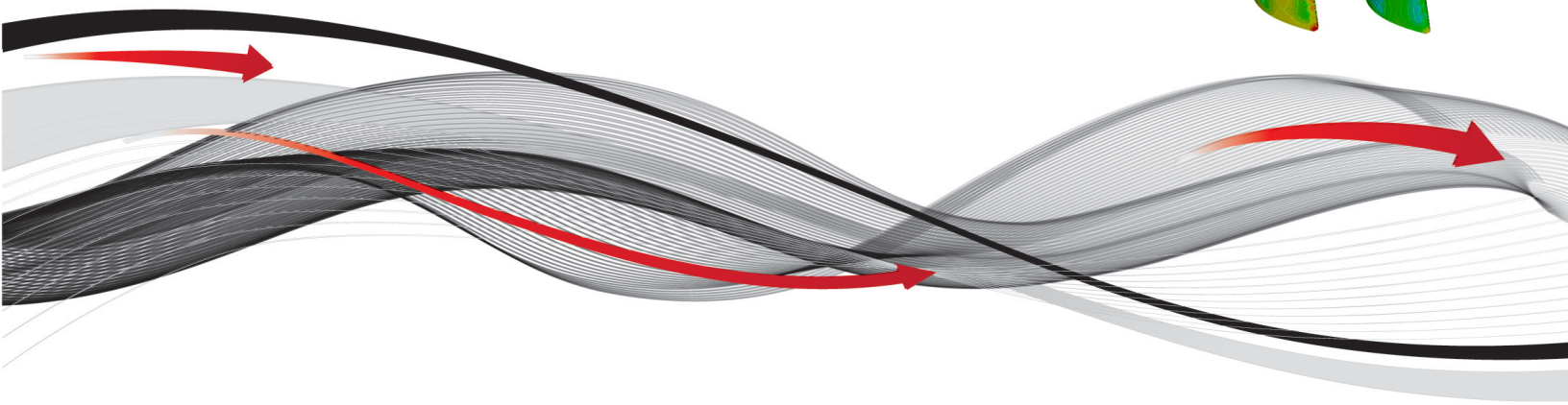
Concepts NREC

**The Experts in Turbomachinery**



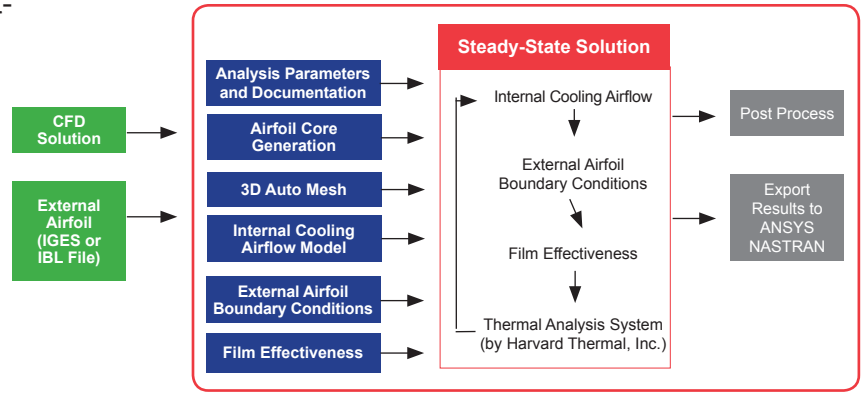


## Cooled Turbine Airfoil Agile Design System

# CTAADS™

CTAADS is a systematic, logical, and rapid 3D modeling approach to cooling-system design for cooled axial turbine vanes and blades. The system includes many special features that can significantly reduce the total time and cost for designing cooled turbine airfoils.

- Integrated suite of independent software modules
- Efficient data transfer and sharing complete 3D thermal analysis including film holes, impingement holes, trailing edge exit slots, pedestals, and thermal barrier coating
- 3D airfoil model represented with geometric finite elements
- Fast finite difference thermal solver TAS™ by ANSYS Corporation
- User-defined pressure loss and heat transfer correlations (for internal cooling airflow model)
- User-defined film effectiveness curves




***CTAADS System Schematic***

## Basic System Components

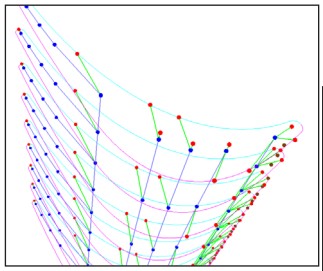
- Airfoil core and 3D solid-model generation
- Automatic 3D mesh generation
- Internal cooling airflow model
- External airfoil boundary conditions
- Film effectiveness
- Automatic boundary conditions mapping
- Steady state thermal analysis
- Postprocessing

## 3D Visualization of Internal Flow Network

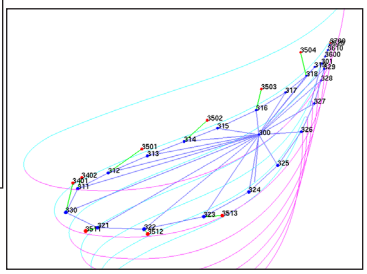
The internal flow network can be visualized in 3D space relative to the cored airfoil, with node and branch information being viewed on the same network, after the “Construct Definition” is executed. The radial flow network shows the internal nodes, boundary nodes, stagnation points, internal branches and Airfoil PS & SS wall contours in different colors for easy identification.

## External Flow Solver

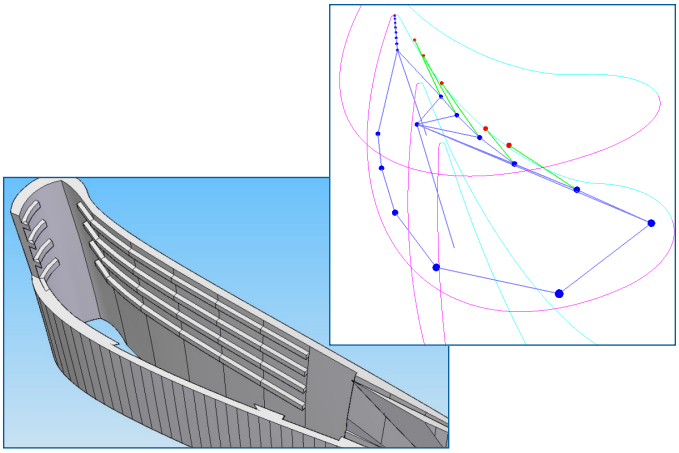
Users can specify a uniform initial external airfoil wall temperature. However, once the steady-state module is started in CTAADS, external wall temperatures are read from the TAS thermal model and the initial estimates no longer apply.



*3D View of Radial Flow Network*



*3D View of Impingement Flow Network*



*Axial Riblet (left), and model view of cooling on one side of airfoil (right).*

## New Cooling Features

Users can model axial riblets that act as axial channels and cooling fans, for single impingement type cooling configurations which will wrap around the airfoil internal wall and break before the TE cooling feature starts. Riblets can be discontinued at LE to allow radial flow. Staggered and inline impingement hole arrangements for single and double impingement type cooling configurations are also available, as well as configurations with impingement cooling on only one side of the airfoil tube (either on PS or SS), and a meter plate on cooling air supply network.

| Concepts NREC’s Agile Engineering Design System® | | Radial | | | | Axial | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Compressors | Fans | Pumps | Turbines | Compressors | Fans | Pumps | Turbines |
| **CAE Preliminary Design** | | | | | | | | | |
| Meanline Approach | AXIAL™ | | | | | √ | | | √ |
| Meanline Approach | COMPAL® | √ | | | | | | | |
| Meanline Approach | FANPAL™ | | √ | | | | √ | | |
| Meanline Approach | PUMPAL® | | | √ | | | | √ | |
| Meanline Approach | RITAL™ | | | | √ | | | | |
| **CAE Detailed Design** | | | | | | | | | |
| 3D Geometric Design | AxCent® | √ | √ | √ | √ | √ | √ | √ | √ |
| Basic CFD Option for AxCent | FINE™/pbCFD* | √ | √ | √ | √ | √ | √ | √ | √ |
| CFD Option for AxCent | FINE™/Turbo™* | √ | √ | √ | √ | √ | √ | √ | √ |
| FEA Option for AxCent | Pushbutton FEA™ | √ | √ | √ | √ | √ | √ | √ | √ |
| **CAE Specialized Design Software** | | | | | | | | | |
| Gas Turbine Blade Cooling | CTAADS™ | | | | | | | | √ |
| Optimization | TurboOPT II™ | √ | √ | √ | √ | √ | √ | √ | √ |
| Rotordynamics | Dyrobes® | √ | √ | √ | √ | √ | √ | √ | √ |
| Gas Turbine Cycle Analysis | Gas Turb® | √ | | | | √ | | | √ |
| **CAM Toolpaths** | | | | | | | | | |
| Base Platform | MAX-PAC™ | √ | √ | √ | √ | √ | √ | √ | √ |
| Flank Milling Option | MAX-5™ | √ | √ | √ | √ | √ | √ | √ | √ |
| Point Milling Option | MAX-AB™ | √ | √ | √ | √ | √ | √ | √ | √ |
| Closed Impeller Option | MAX-SI™ | √ | √ | √ | √ | √ | √ | √ | √ |
| Single Blade Option | MAX-SB™ | √ | √ | √ | √ | √ | √ | √ | √ |

*Offered in partnership with NUMECA International as part of the FINE/Agile™ integrated suite.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