

# CFD-based design exploration for gas turbine cooling

## Increase gas turbine efficiency by operating at higher temperatures without overheating

#### **Benefits**

- Minimize the amount of air needed to cool gas turbine (GT) blades and vanes
- Easily and accurately predict flowinfluenced metal temperatures throughout the solid blades and vanes
- Identify hot spots and contribute to better thermal stress and life predictions
- Accelerate innovation by rapidly exploring more blade-cooling designs

#### Summary

- Obtain better metal-temperature predictions with Conjugate Heat Transfer (CHT)
- Discover better designs, faster by automating CFD-based design exploration
- Improve realism and accelerate simulation throughput by using high-fidelity geometry from 3-D CAD



CHT results show the temperature gradients throughout the 3-D solid metal blade of the GT.

#### Better metal-temperature predictions

Conjugate Heat Transfer (CHT) in STAR-CCM+<sup>®</sup> software solves simultaneously for fluid and solid temperatures in the gas turbine, yielding an accurate prediction of metal temperatures and gradients.

They, in turn, yield more accurate thermal stress predictions without any back-and-forth iteration.



CAD

Velocities

### **Temperatures**

CHT model in STAR-CCM+ calculates flow velocities and temperatures on complex, full geometries.

### More design exploration

Why perform just a few simulations when you can rapidly perform hundreds and automatically explore your design space using intelligent search techniques?

Understand design sensitivities and inform your design-decisions when making difficult trade-offs with HEEDS<sup>™</sup> software for design optimization.

### Streamlined simulation for more throughput

Perform your CFD simulation using the complete "master model" of your gas turbine – with the full-fidelity geometry obtained directly from your 3-D CAD model and PDM system.

No need to use lower-fidelity (1-D or 2-D) flow predictions based on approximations and simplifying assumptions. Don't waste time performing tedious, error-prone de-featuring of your 3-D CAD model.

Automated CAD cleanup and robust meshing in STAR-CCM+ lets you spend less time modeling, and more time deriving insight from realistic 3-D CFD simulations.



Understand the trade-off between cooling effectiveness and mass flow rate with design exploration (Courtesy: B&B-AGEMA).



An easy-to-create conformal mesh between the fluid region (purple) and solid region (gray) improves the accuracy of CHT.

Thin prism layers in the fluid region accurately capture the boundary layer effects.



3-D CAD of the gas turbine blade's complex internal cooling passages (green and pink).

A polyhedral mesh of the blade's outer metal (gray) and internal cooling passages (green and pink).

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