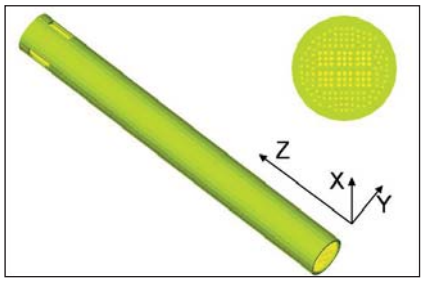
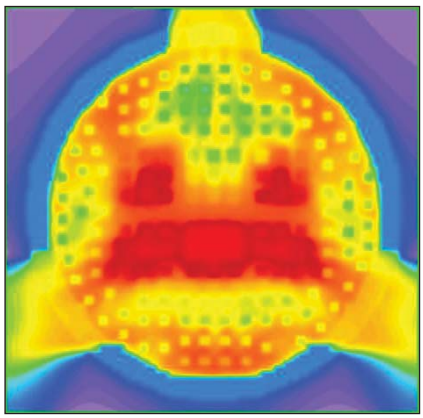
Thermal Loading of RF Antenna for Radar Test Bed

Radar Test Prototype



Flight Shaft Model



Temperature Distribution at Shaft Cross-section

Design Challenge

This case study refers to a prototype antenna system used for development in the UESA (UHF Electronically Scanned Array) Radar Test Bed at the Advanced Airborne Test Facility (AATF) on Kauai, Hawaii.

The thermal management of the RF power driven into the radome through the flight shaft was ascertained. Since there were over 160 cables driving power through a small flight shaft, the thermal loading of the cables within the flight shaft was of concern to ensure the bundled cable lines did not exceed their allowable rated temperatures for performance and most importantly, failure and meltdown.

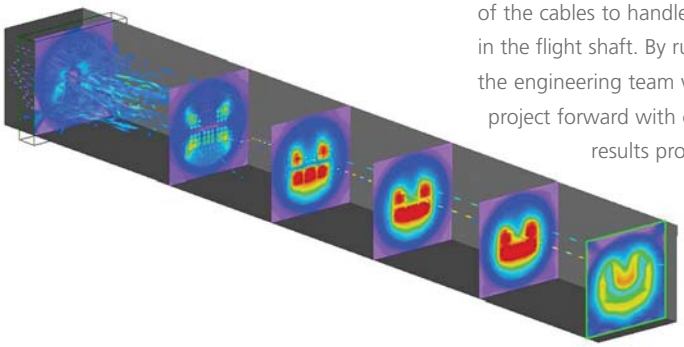
Solution and Benefits

Robert Will, mechanical engineer, and thermal analyst, decided to model the flight shaft problem in Flotherm.

The model consisted of individual cuboid elements representing each cable, and orthotropic material properties were created and attached to the specific elements. The flight shaft geometry was generated in CAD and imported into Flotherm to maintain accuracy of the geometry model.

Maximum power values were inputted per cable to represent the worst case power generation for the application. Furthermore, flow resistance models were developed to simulate the complex nature of the twisted and bundled cables through the flight shaft. In addition, an air amplifier creates a forced air flow through the flight shaft to assist in the cooling. That was modeled as a forced convection flow.

Varying the flow resistance through the flight shaft allowed engineers to see the impact of worst-case models at full power. Fortunately, there was ample margin in the material properties of the cables to handle the high temperatures in the flight shaft. By running these simulations, the engineering team was able to move the project forward with confidence knowing the results provided by using Flotherm.



Temperature & Flow along Shaft

Customer Testimonial

"Flotherm enabled me to take a complex problem and analyze various solutions in a time-efficient manner. It also provides my team a way to visually see the results in an easy to understand graphical depiction of the problem."

Robert Will, Sr. Mechanical Engineer

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