PERMAS
Design of Mechatronic Devices by Electro-Thermal FE Analysis and Coupled CFD Analysis

Power module

Engine cooling module

Inner cavity
✓ Convection
✓ Radiation

Air flow

Heat sink

Electrical devices
✓ Joule effect

Structure

Current density

Heat sources

Flow and temperature

Bidirectional coupling

Temperature

Fluid

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Temperature and streamlines in the fluid

OpenFOAM CFD results

Temperature in the structure

PERMAS results
Steady-state electric current

PERMAS Electromagnetics

- Steady-state electric and magnetic field computations
- General dynamic electromagnetics, inductance, and wave propagation
- Absorbing boundaries and infinite elements for unbounded domains
- Joule heat sources for subsequent thermal analysis
- Electromagnetic forces for subsequent structural mechanic analysis

- 3D modeling
- Convenient incompatible meshing for all kinds of DOF
- Fully integrated: one model for all physics

PERMAS Heat Transfer

- Convection elements
- Efficient radiation computation (octree algorithm) for any kind of cavity under the grey body assumption, check of view factors
- Fully integrated solution with structural mechanics

Temperature

Radiation flux in the cavity

Temperature in the structure

Fluid temperature near the structure

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