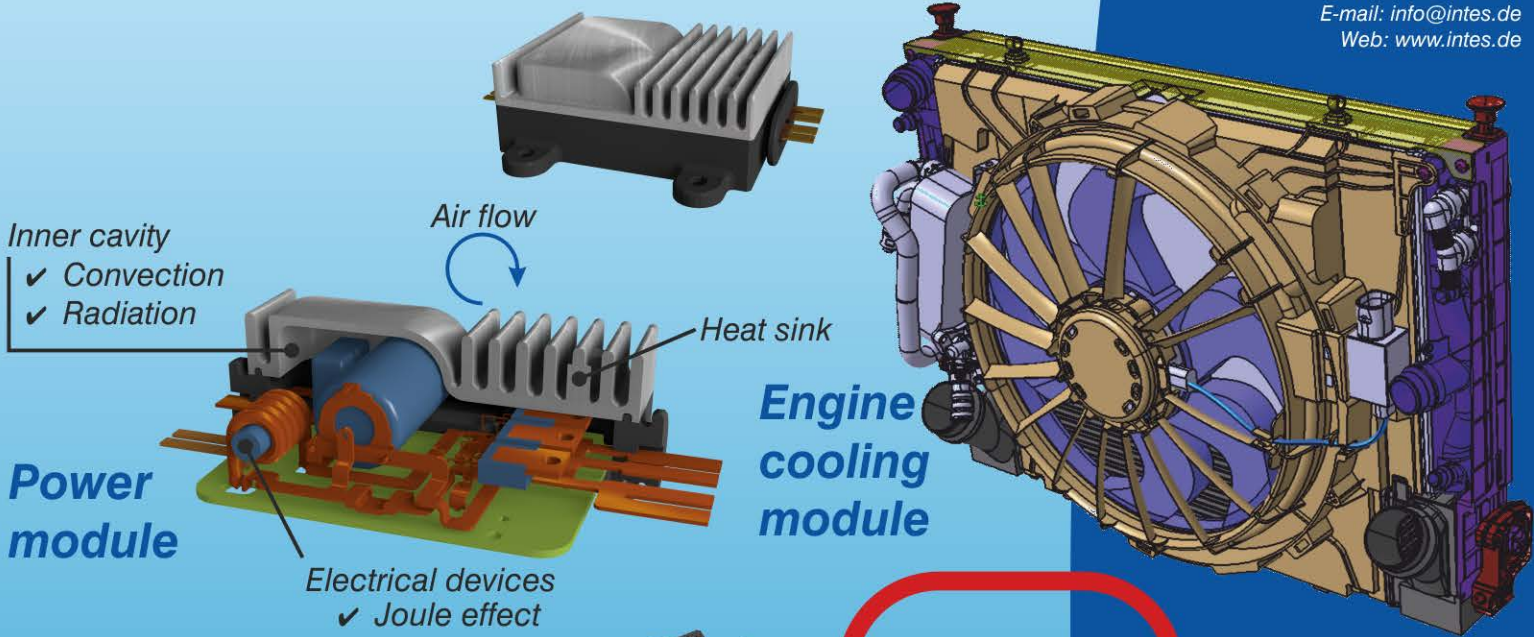# PERMAS

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

INTES GmbH
Schulze-Delitzsch-Str. 16
D-70565 Stuttgart
Phone: +49-711-784 990
Fax: +49-711-784 9910
E-mail: info@intes.de
Web: www.intes.de

Air flow

Inner cavity
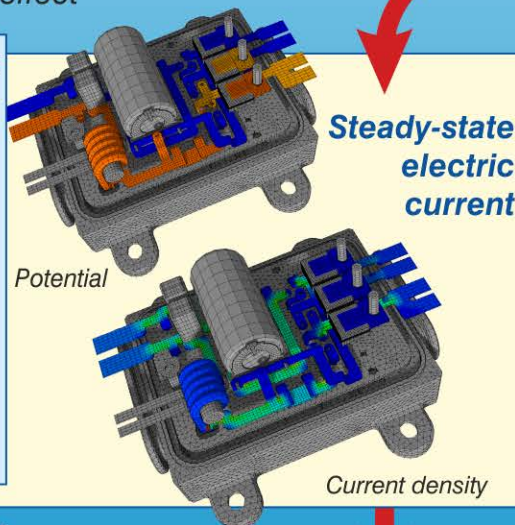- ✔ Convection
- ✔ Radiation

Heat sink

Power module

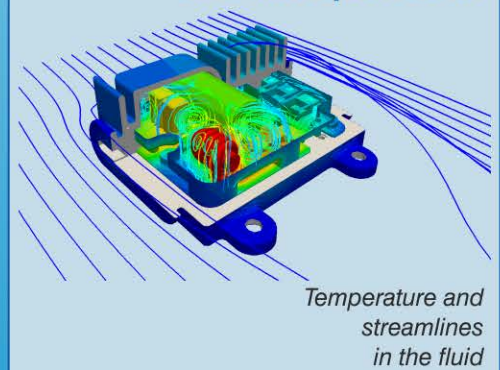Electrical devices
- ✔ Joule effect

Engine cooling module

PERMAS *Elektromagnetics*

- ✔ Steady-state electric and magnetic field computations
- ✔ General dynamic electro-magnetics, 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
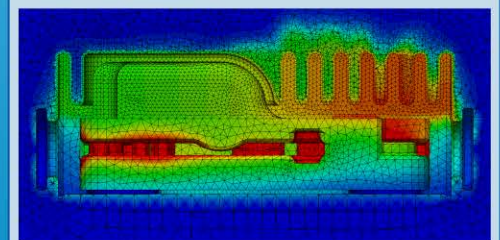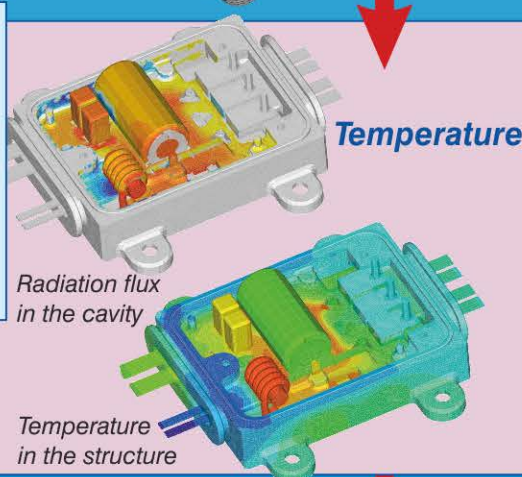
Potential

Steady-state electric current

Current density

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

Radiation flux in the cavity

Temperature in the structure

Temperature

CFD mit OpenFOAM

Temperature and streamlines in the fluid

Fluid temperature near the structure

CFD computations were performed with
Open∇FOAM © Copyright OpenCFD Ltd.