EFI - OptiGrip.

MULTIPHYSICS

CORE COMPETENCIES

1 Simulation driven design
2 Thermal engineering
3 Electromagnetism
4 Instrument development

Thermal simulations to avoid overheating

With so-called keyhole surgery, thin tubes enter the body via small incisions. Grippers on the tip of these tubes manipulate the body tissue, and a small camera enables the surgeon to visualize what the grippers are doing. However, traditional keyhole surgery instruments lack so-called haptic feedback – the feeling of resistance with your fingers when you grip something. This feedback assists in "feeling" what you are doing. As traditional instruments lack haptic feedback, the forces exerted on tissue are typically threefold larger than required, increasing the chances on complications and tissue damage.

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Demcon co-developed the OptiGrip: a sensitive instrument for keyhole surgeries with haptic feedback. Optic sensors in the gripper measure the force needed to grasp body tissue. This force is transmitted to a small actuator in the handle of the instrument, which gives force feedback to the surgeon. Consequently, the surgeon feels the force exerted on the body tissue. To give an example: a surgeon can feel the difference between a vein and an artery.

Demcon multiphysics took part in the development of this instrument. Our goal was to prove that the thermal requirements are met: ensure a sufficiently cool casing, and to avoid overheating of the actuator. Inside the instrument, a small electromagneticactuator is present which actuates the haptic feedback. In the magnetic coil, heat is generated. This heat is transferred from the actuator to the outer side of the casing.

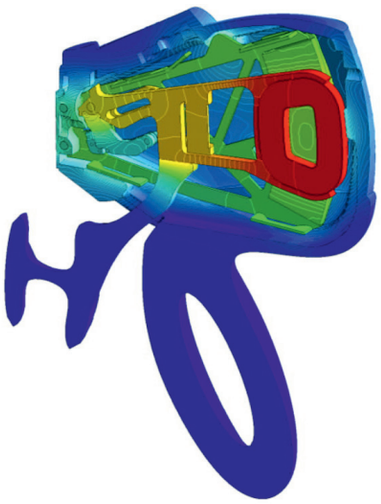

Figure 1 Inside temperature distribution determined with simulations employing a so-called conjugate convective heat transfer model

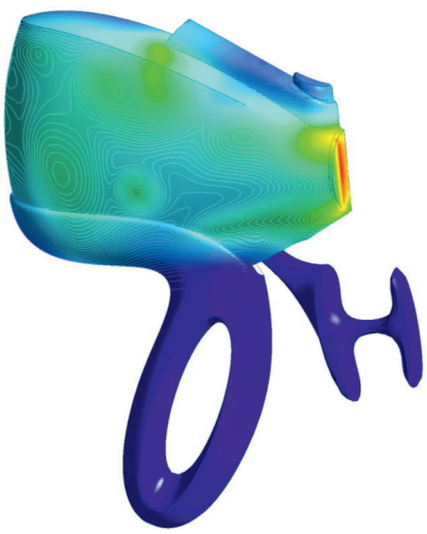

Figure 2 Outside temperature distribution determined with simulations

Using computation fluid dynamics (CFD) simulations, we calculated heat transfer in the instrument, while focusing on the casing, the handle, and the motor temperatures.

We combined fluid flow and heat conduction through structural parts, using a so-called conjugate convective heat transfer model. Initial simulations showed clear room for improvement, and several design iterations were needed to ensure sufficient heat transfer towards the environment. To calculate the warm-up and cool-down times, we made use of transient simulations, as shown in the pictures.

To conclude: Demcon multiphysics assisted in the thermal design of the EFI OptiGrip to ensure that the design complied with all thermal specifications. Currently, this instrument is commercially available.

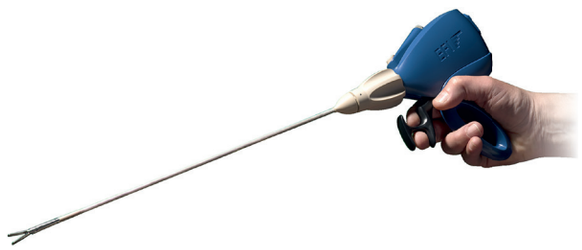

Figure 3 The OptiGrip, a surgical instrument with feeling

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