

COMPUTER SIMULATION

Finite Element Analysis

In the field of medical products the Finite Element Analysis (FEA) is increasingly used more and more to perform strength analysis and design optimizations without the need for time- and cost-intensive prototyping of a product. The rapidly increasing computer performance enables a low-cost simulation of complex components or composite structures. Different medical and technical demands on the modelling (multibody contact problems, dynamic load cases) or material laws (plasticity, anisotropy, viscoelasticity) can be examined by FEA. Even complex manufacturing processes like forging or casting can be performed.

Beside the testing of components and experimental mechanics, the FE analysis is a main focus in our company. This enables a close link between simulation and experiment and offers the possibility of a critical judgement of FE results.

The following models show some FE examples of the range of application in the medical industry performed by Endolab:

Hip endoprotheses

For a realistic simulation of the mechanical strength of femoral heads and cups of artificial hip joints, the knowledge of the complex failure mechanisms and the complete simulation of the contact and friction behavior between stem and head and between insert and metal-back is necessary. The process of the contact simulation is applicable to many modular connection techniques. The exact modelling of the geometry (precision less than 1µm) is important especially for hard-hard couplings such as ceramic-ceramic. [Fig. 1]

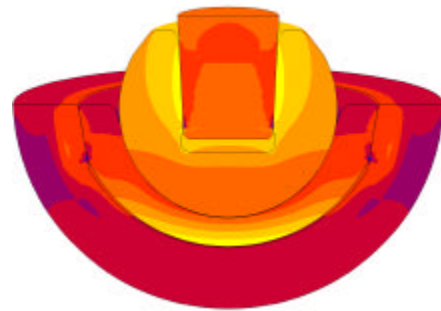


Fig. 1: Multibody contact problem

Stents

The formulation of the elastic-plastic material behavior is of great importance to the simulation of the dilation of coronary vessel implants (stents). In the stent analysis the mechanical boundary conditions during the dilation or the in vivo loadings are applied. Parallel examinations of design variations based on existing implants are possible to determine the strength of the component. [Fig. 2]

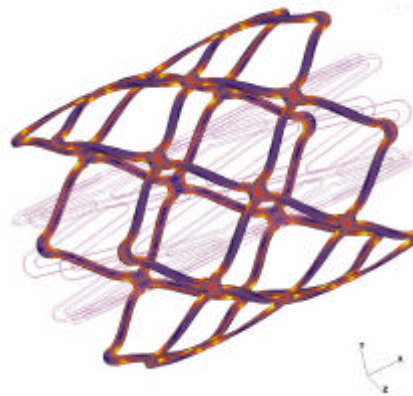


Fig. 2: Dilation of a stainless steel stent

Composite materials

Usually the calculation of hip stems can be done by simple analytical methods. In the case of complex geometries and material behavior the analytical way comes up against limiting factors. In accordance to the general advantage of the FE analysis, the calculation can be advantageous considering the economic factor. Fig. 3 shows a hip stem made of carbon-fiber reinforced epoxy resin. The anisotropic material properties combined with free-form surfaces can only be determined by FE analysis.

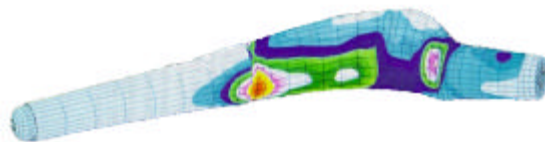


Fig. 3: Hip stem made of CFRP

Description:

FE program: MARC K7.3 (MARC Analysis Research Corp.)
Pre- and postprocessing: Mentat 3.2 (MARC)

Literature:

Please contact Endolab GmbH

Links:

www.endolab.de
www.marc.com