NX Topology Optimization: Conceptual design through FEA

NX CAE

Benefits

- Design parts right the first time by starting with an optimized concept
- Accelerate product development by reducing design and analysis cycles
- Develop lighter, yet stronger components
- Improve product durability
- Leverage your CAD and CAE investments through seamless integration in NX

Summary

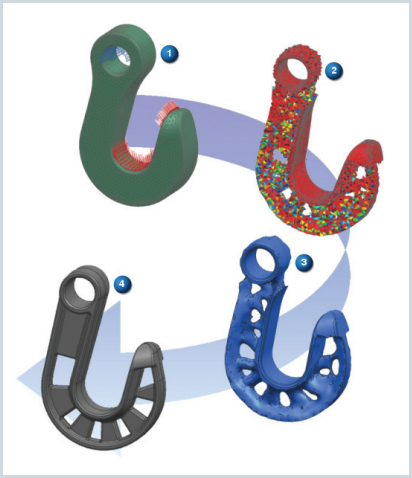
NX™ Topology Optimization brings simulation to the earliest stage of conceptual design. Topology optimization helps analysts reduce component weight by computing a conceptual optimal design based on a finite element model of the design space and loading conditions. Integration in the NX environment allows easy collaboration between analysts and designers because the raw conceptual design geometry can seamlessly be handed to designers for further refinement.

Optimize before design begins

NX Topology Optimization can help you to develop a new component by providing you with optimal design suggestions before detailed designs begin. The raw conceptual design is calculated based on finite element analysis results of loading conditions applied to a FE model of the component package space.

NX Topology Optimization is an add-on to the NX Advanced Simulation product, and so set up of the topology optimization model is very simple:

- Create a FE model of the design space, loads, and boundary conditions within NX Advanced Simulation
- Define which elements in the model that the optimization can modify
- Define a design objective, such as maximizing stiffness
- Define design constraints, such as volume, and also manufacturing constraints to ensure that the component can be produced



1. Design area for optimization
2. Optimized model
3. Smoothed model
4. Final CAD design

NX

www.siemens.com/nx

SIEMENS

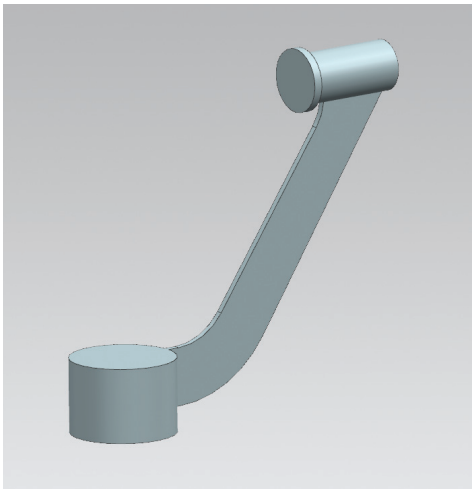
NX Topology Optimization

The embedded NX Nastran solver then solves the FE model, and the optimization engine uses the NX Nastran results to compare against the design objectives. Working within the design constraints, the optimization engine modifies the material distribution by adjusting the material's Young's Modulus of the elements in the design area, and then re-solves the new FE model in NX Nastran. The optimization process iterates until it achieves an optimal solution that satisfies the objectives and constraints.

Seamlessly from concept to initial design

The resulting optimized FE model is not in an ideal format for design purposes. However, NX Topology Optimization can create smoothed representations of the optimized FE model. A designer can seamlessly take this smoothed model into NX CAD to use as a starting point for refining the initial concept model into a manufacturable component. The real benefit is that the initial design is based on calculated product performance results rather than educated guesswork, and topology optimization will help you develop products right the first time.

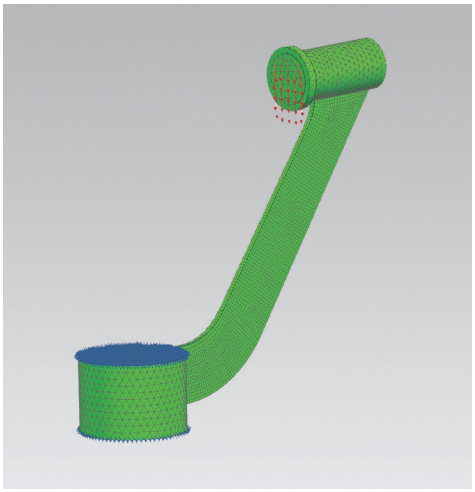
Concept for camera gimbal design.



Design space geometry.

General capabilities

- Topology optimization with NX Nastran for linear statics and normal modes analyses
- Pre- and postprocessing with NX Advanced Simulation
- Based on best-in-class optimization system TOSCA Structure, by FE DESIGN GmbH
- 2D and 3D finite element meshes
- Linear and parabolic elements
- Contact definitions within the FE model
- Consideration of multiple load cases
- No model parameterization necessary
- Stable and fast optimization algorithms
- Efficient handling of very large models
- Multiple topology optimization runs from the same FE model to further explore the design potentials



FE model of design space with loading conditions.

Optimization targets
- Strain energy (stiffness)
- Volume
- Node displacement
- Eigenfrequency

Optimization constraints
- Volume
- Frequency
- Displacement

Manufacturing constraints

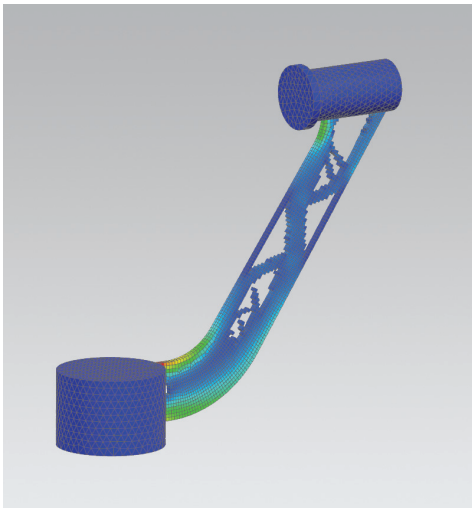
Cast conditions
- Design Area or a portion of the model
- Cast pull direction
- Draft angle
- Methods to define the Mid-Plane

Symmetry constraints
- Cyclic Symmetry
- Plane Symmetry

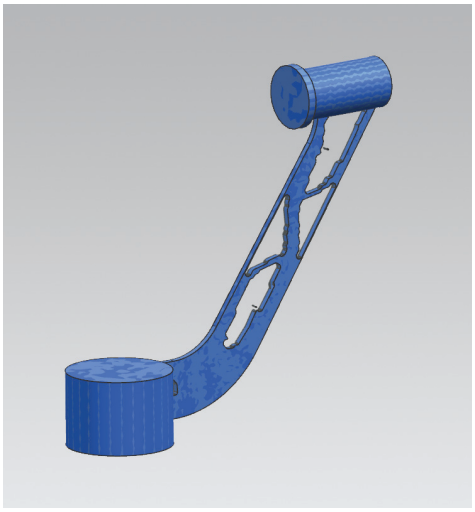
Rib/connecting member constraints
- Minimum & maximum

Element constraints
- Frozen restriction to define certain elements that should not be modified during the topology optimization process

Design smoothing
- Automatic generation of smoothed surfaces of the material distribution following topology optimization
- Specification of the target volume for the surface calculation
- Export smoothed part using STL, Nastran BDF or IGES Slices
- Run smoothing as part of optimization process or as separate process afterwards



Optimized concept with stress results.



Smoothed surfaces from conceptual optimization that designers can use as starting point for design.

Contact
Siemens Industry Software
Americas +1 800 498 5351
Europe +44 (0) 1276 702000
Asia-Pacific +852 2230 3333

www.siemens.com/nx

X5 25607 9/11 C