Morphorm Design Optimization Software

Design Optimization Innovation for Rapid Product Design

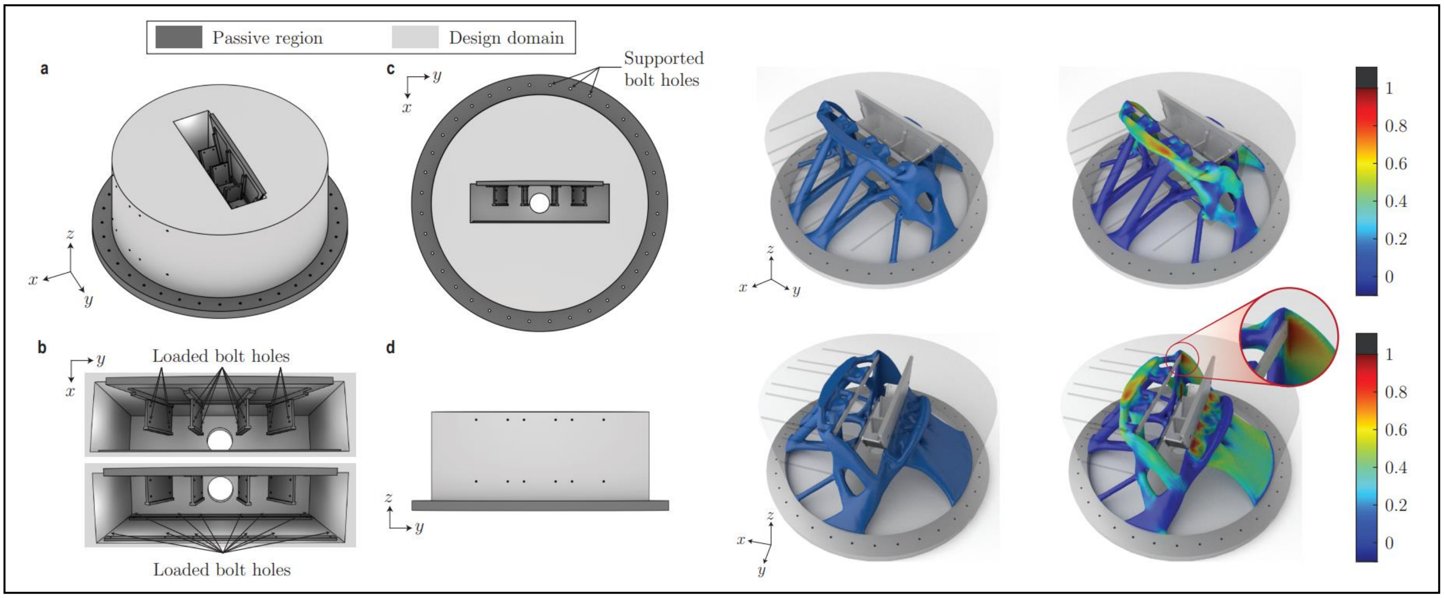

Figure 1. The ***left pane*** *shows the design domain and the passive region (material is not added nor removed in the passive region) for the design study. The boundary conditions and loads used for the design study are also shown in the left pane. The topology optimization problem seeks to reduce the weight of an antenna support bracket while satisfying a von Mises stress limit at every material point. The* ***right pane*** *shows the optimized antenna support bracket and the normalized von Mises stress. The von Mises stress is normalized with respect to the stress limit. Results show that the von Mises stress limit is satisfied at every material point.*

Overview

Morphorm is building optimization and simulation engineering technologies to deliver real-time design solutions, with a strong focus on aerospace and defense applications. We are on a mission to employ advanced scientific computing to solve complex science and engineering problems.

Highlights

Features

- High performance computing enabled multi-physics analysis and optimization solvers
- Multi-GPU accelerated multi-physics analysis and optimization solvers
- Massively parallel data manager to facilitate concurrent design performance evaluations
- Design for multi-physics environments
- Design for additive manufacturing by controlling undercuts and the minimal overhang angle

The Morphorm design optimization module applies novel simulation driven-design methods to create optimized designs. It combines multi-physics finite element analysis and topology or shape parameter optimization to identify design concepts that meet user-specified performance and manufacturability requirements. In other words, the user specifies the “function” and the Morphorm software determines the “geometry”. The Morphorm design optimization module accelerates design discovery through parallel and heterogeneous programming models. It allows users to combine multiple graphical processing units (GPUs) and central processing units (CPUs) to rapidly identify optimized design concepts.

Multi-Physics Optimization

Apply multi-physics design criteria in a design study for increased fidelity. The following finite element solvers can be used for design optimization:

- Thermal
- Electrical
- Mechanical

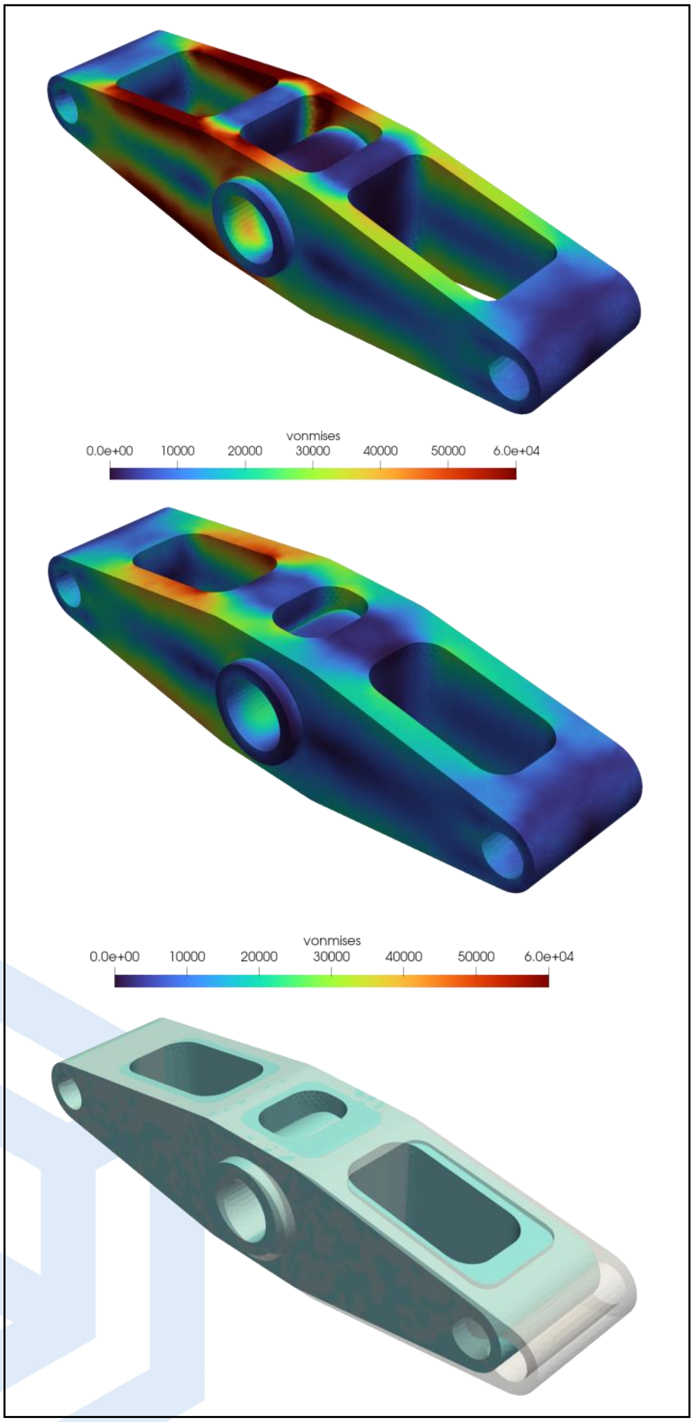

*Figure 2. The shape optimization problem seeks to reduce the maximum von Mises stress while satisfying a mass limit. The **top pane** shows the von Mises stress for the baseline design. The **middle pane** shows the von Mises stress field for the optimized design. The maximum von Mises stress of the optimized design is 26% less than the maximum von Mises stress of the baseline design. The **bottom pane** shows the optimized design (cyan) overlaid on top of the baseline design (gray.) A 15% weight reduction is achieved.*

- Thermal-Electrical
- Thermal-Mechanical

Geometric nonlinearities can be considered when using the mechanical and thermal-mechanical finite element solvers in a design study. A wide range of design criteria are supported for all the physics.

Topology Optimization

Topology optimization is a mathematical method used to optimize the material layout of a physical system given a set objective and constraint functions. In topology optimization, the optimizer is free to choose any material layout within the design space that satisfies the objective and constraint functions.

Additive Manufacturing Restrictions

Additive manufacturing facilitates the fabrication of parts with organic shapes. For any topology optimized part with undercuts, sacrificial support structures are needed to support subsequent material layers. Removing support structures can lead to the deterioration of surface quality where the support structure meets the part. Morphorm provides design criteria to control the minimal overhang angle in a topology optimized part. Thus, creating a self-supporting part for additive manufacturing.

Length Scale Restrictions

Restrict the minimum length of structural features to improve manufacturability.

Shape Optimization

Shape optimization is a mathematical method used to optimize the shape parameters of a physical system given a set objective and constraint functions. Shape optimization methods operate on a restricted set of geometric features that define the geometry of a physical system, e.g., CAD shape parameters.

Design of Experiments

Design of experiments is a mathematical method that enables users to extract knowledge about how variations in the parameter inputs, e.g., boundary conditions, loads, material properties, impact the performance of the optimized design.

Surrogate-Based Optimization

Apply Bayesian optimization to accelerate expensive design studies. The approach builds an initial Gaussian Process (GP) model as a global surrogate for the response function. Then, it intelligently selects additional high-fidelity samples through online training to improve the predictive efficacy of the GP model as the design study progresses.