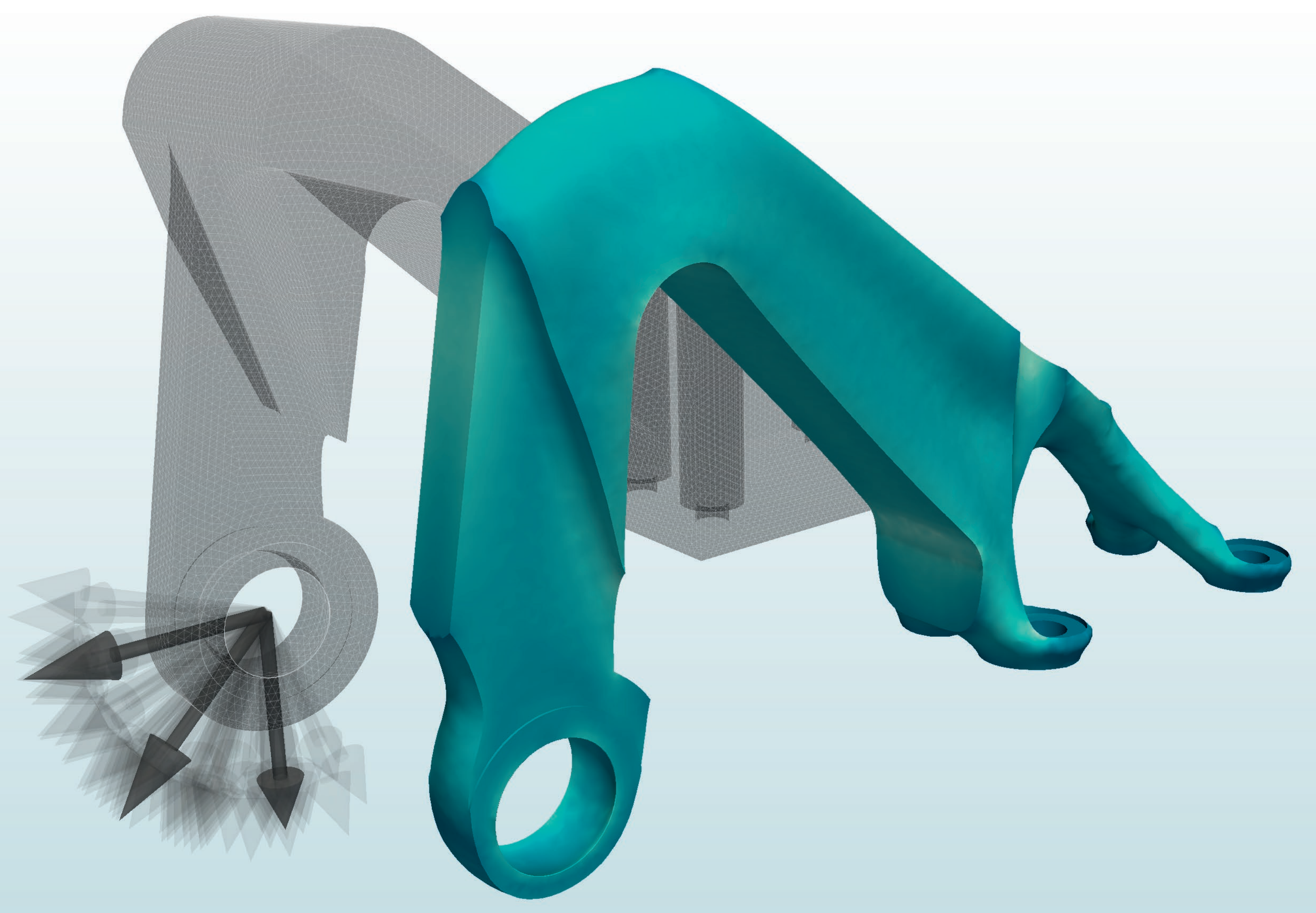


Safer lightweighting with stochastics

Topology optimization for robust design
Stochastic modelling represents real-life variability in loads and material properties. Considering this variability during topology optimization is critically important and enables you to automatically create robust designs that behave safely, even in off-design conditions. Because they are optimized for thousands of real-life loading scenarios at the same time, you can have confidence in your lightweight product designs.

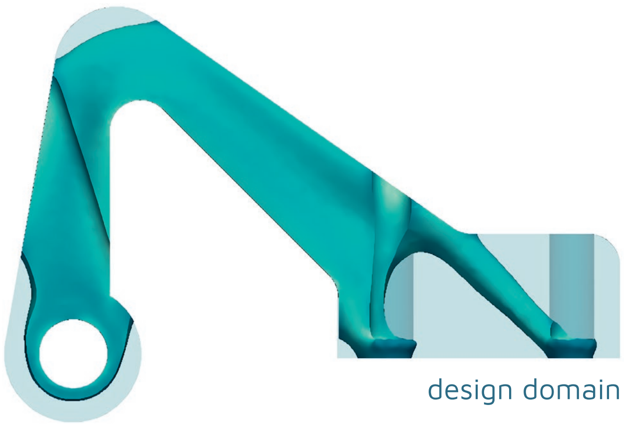
Rafinex S.à r.l. // Rafinex Ltd.
Berlin - London - Luxembourg

contact@rafinex.com
www.rafinex.com

Stochastic Topology Optimization - What is it?

Unlike current software, Rafinex's stochastic topology optimization accounts for thousands of real-life conditions simultaneously. It overcomes classical limitations by representing real-life variability in load directions and material properties. Considering all these uncertainty sources at the same time is what makes this next-generation technique so powerful.

You will generate designs which are proven to be more robust and safer, even in off-design conditions. Additionally, you obtain one single optimized design which meets all your requirements, rather than having to manually combine several design solutions, each individually optimized for one load case only. This saves you months of valuable engineering time.



Robust, safe and predictable lightweight designs are obtained because uncertainties in applied loads and material properties are considered concurrently. The resulting designs exhibit much lower maximum displacements, von Mises stress and compliance sensitivities – proving your designs to be more robust, safer and more reliable.

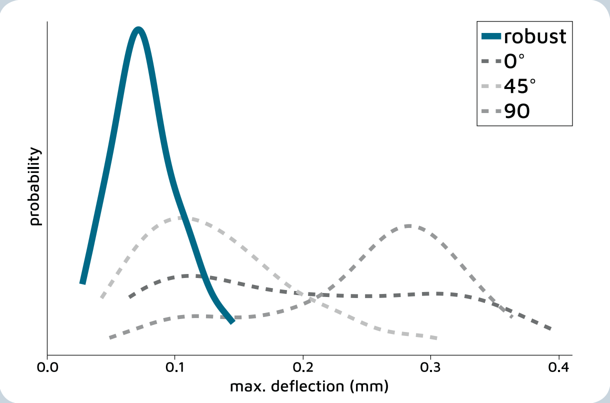
Stochastic topology optimization not only gives you one single optimal design but also computes quantifiable safety levels, such as survivability probabilities. You obtain optima you can trust.

Next-generation topology optimization, running on cloud supercomputers and with reliable expert support – at your fingertips and ready to run. Rafinex's proprietary approach, using adaptive and intelligent algorithms, gives you results in minutes and saves you months of product design time.

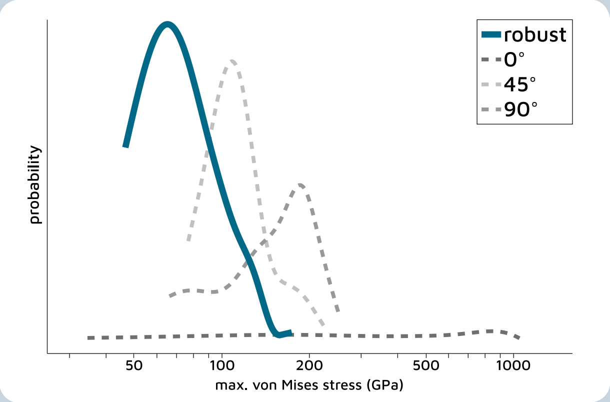
Our web platform removes the entry barriers, unlocking these benefits for you and your customers.

Designs proven to be safer and more robust

A reduction in maximum displacement is obtained for designs which are optimized with a stochastic approach. Across all load scenarios the stochastic design has both a lower displacement and narrower variability when compared to the three classically optimized designs. This robustness and predictable behaviour during off-design load scenarios are vital for safe leightweighting.



Reduced maximum von Mises stresses are observed in robust designs. Our robust design not only has the consistently lowest maximum von Mises stress state, but these stress states are predictably contained within a narrower range.



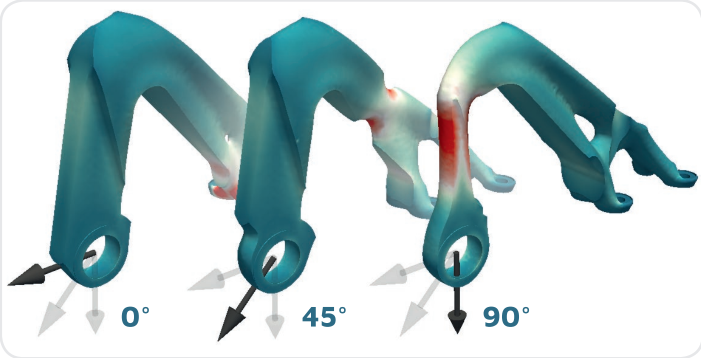
Your lightweight designs can be optimized while you know them to be safe during real-life service conditions.

Finally, robust designs also have lower fluctuations in maximum von Mises stresses across all load conditions, making them safer for fatigue.

Be confident about your design limits and set safety requirements

Classical topology optimization, using a deterministic approach to loads and material properties, result in designs which are each optimized for one specific load scenario. These designs can quickly become unsafe when applied loads are off-design.

The Conditional Value at Risk (CVaR) for the von Mises stress, shown to the right, quantifies your design's weak points and limitations.

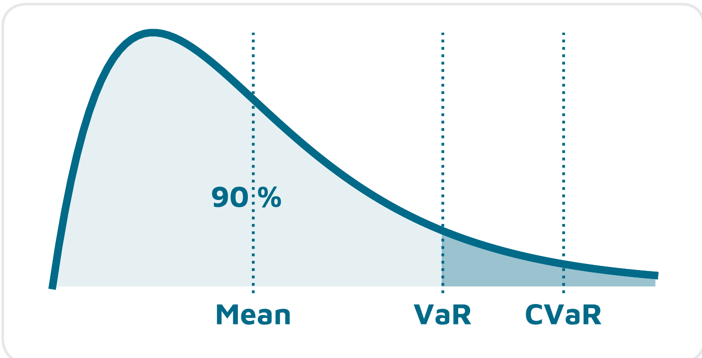


Robust designs have consistently lower risk everywhere in their domain. Stochastic topology optimization yields designs which have lower and more uniform Conditional Value at Risk for the von Mises stress, shown here for the worst 10% of load scenarios.

You are free to choose different cut-off percentages for your CVaR to match your design safety philosophy, material failure criteria and product quality control requirements.

Conditional Value at Risk
indicates the average of a quantity's most extreme fraction of loading scenarios, such as the worst 10%. This cut-off is freely choosable, so you can set more stringent requirements for the von Mises stress.

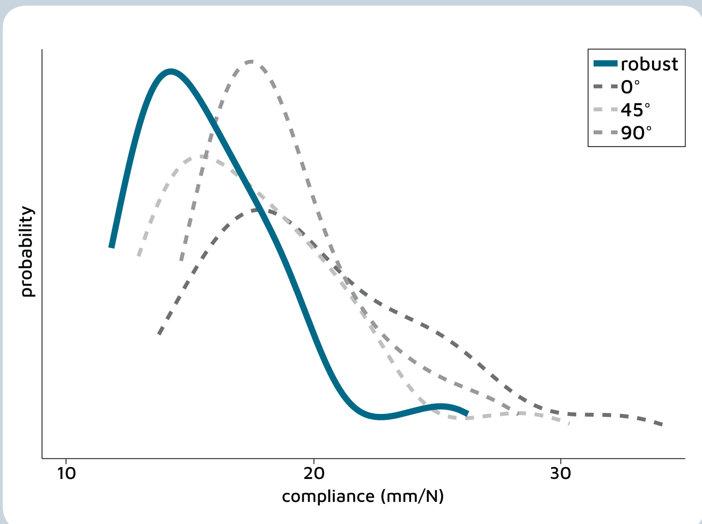
The CVaR quantifies your risk and answers questions such as "What happens in the most extreme cases?" allowing to quantify your material property limits and adapt your safety requirements.



Designs proven to perform in off-design conditions

Be confident in your designs
because you have quantified thier limits and made sure that they are safe – without having to compromise on performance. The robust aircraft bracket, shown above, not only has the best displacement and von Mises stress characteristics, but it also exhibits the lowest mean, and variability of, compliance at the primary load point.

Stochastically optimized designs are robust, safe and predictable in performing their function.



rafinex

Who we are

Rafinex was formed by people who believe that advanced mathematics can bring so much more impact to engineering. By combining best-in-class algorithms and AI-assistance when needed, we are striving to find and provide the world's most advanced and most appropriate numerical methods for your challenging needs - ready to use and packaged as cloud simulation apps with built-in expert know-how.

Rafinex goes beyond current market tools by accounting for real-life variability using uncertainty quantification methods and by considering manufacturability; allowing safe and profitable usage by everyone in engineering design.

contact@rafinex.com
www.rafinex.com

Rafinex S.à r.l.
L-1670 Senningerberg, LUX
RCS Luxembourg: B232233
Permits: 10099703/0-1

Rafinex Ltd.
Harmston, LN5 9GF, UK
Registered in England: 11627959

Johannes Neumann, Dr. rer. nat.

Johannes Neumann researched physical simulations with stochastic uncertainties and robust topology optimization at the Weierstrass Institute for Applied Analysis and Stochastics (WIAS) in Berlin.

His focus on accelerating the numerical calculation unlocked the practical applicability of stochastic methods in a business environment. He has a wide network of scientific contacts across Europe in the field of numerical mathematics.

Abeed Visram, PhD

Abeed Visram specialized in high-performance computation of fluid dynamics (CFD) at Imperial College London. His collaboration with the UK Meteorological Office investigated the numerical stability of long-term weather forecasts in which the smallest numerical inaccuracies distort the forecast.

Subsequently, he worked on simulation automation in the CFD Technology department of McLaren Racing Ltd before joining Spirable Ltd as Head of Innovation and cloud architect.

André A.R. Wilmes, PhD

André Wilmes has developed numerical methods for simulating composite nano-materials at Imperial College London and has given guest seminars at leading research centers including NASA and TU Munich.

He has experience as an R&D project manager in the ceramics and manufacturing industries, where he developed new simulation methods and experimental prototype processes in a variety of material topics ranging from fracture mechanics to optics.