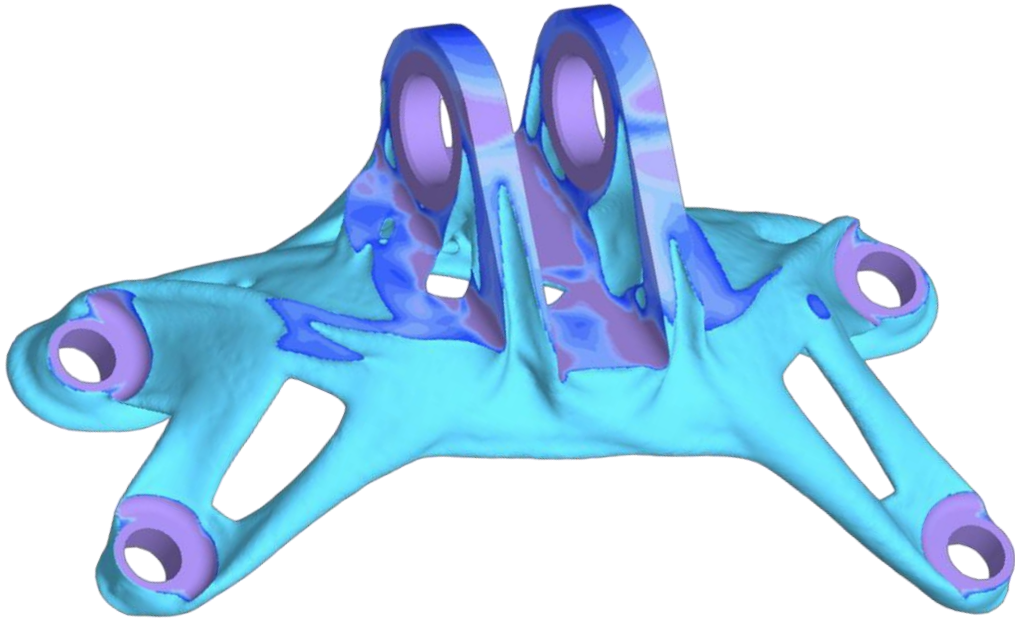




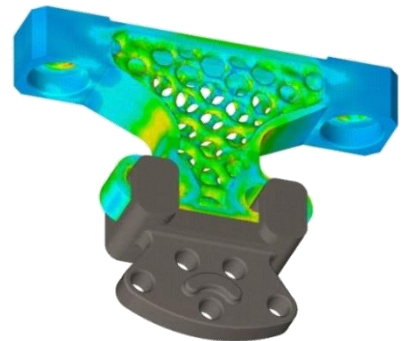
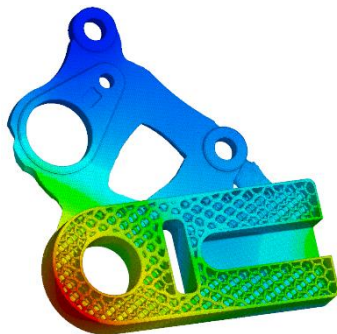
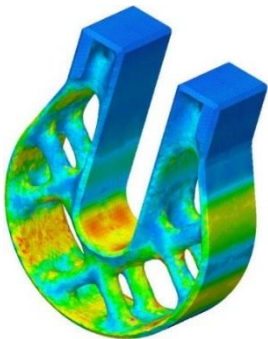
**CAESS**

Center for Advanced Engineering Software and Simulations

**GIA**



# ProTop® / ProTopCl®



High performance topology  
optimization developed by  
engineers for engineers



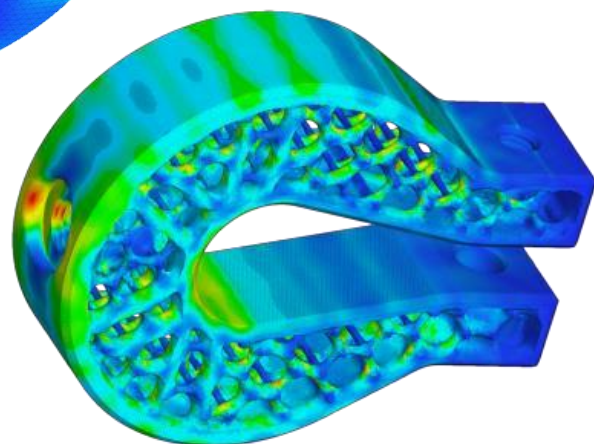
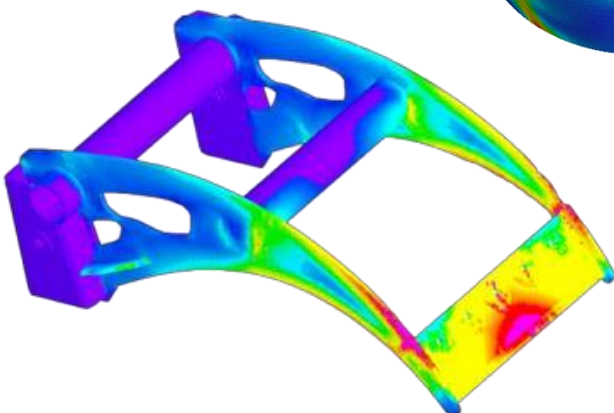
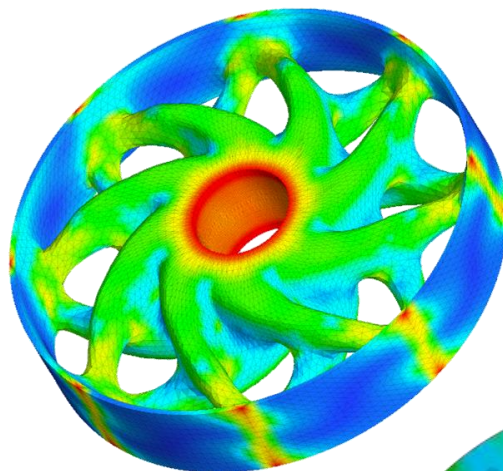
partner network  
channel

ProTop® / ProTopCl® is a standalone topology optimization software.

It takes as input FNF and INP files, generated by PTC® Creo® and Simulia Abaqus®, SolidWorks® Simulation.

## Explore ProTop® and ProTopCl® Capabilities

- Easily find minimum-strain energy designs that exhibit minimal stresses, while efficiently removing stress concentrations.
- Prolong the life span and increase the resistance to crack fatigue of your structural parts.
- Reduce the weight and material cost of your products.
- Efficiently solve multi-million-element models, involving contacts and plasticity if required.
- Deliver high-quality optimized designs.
- Smooth and improve the design obtained, and export it to popular CAD and 3D printing formats.
- Easily create innovative shell or/and lattice designs.
- Generate and adjust your desired lattice configuration on the fly.
- Immediately optimize your lattice structure to remove stress concentrations.

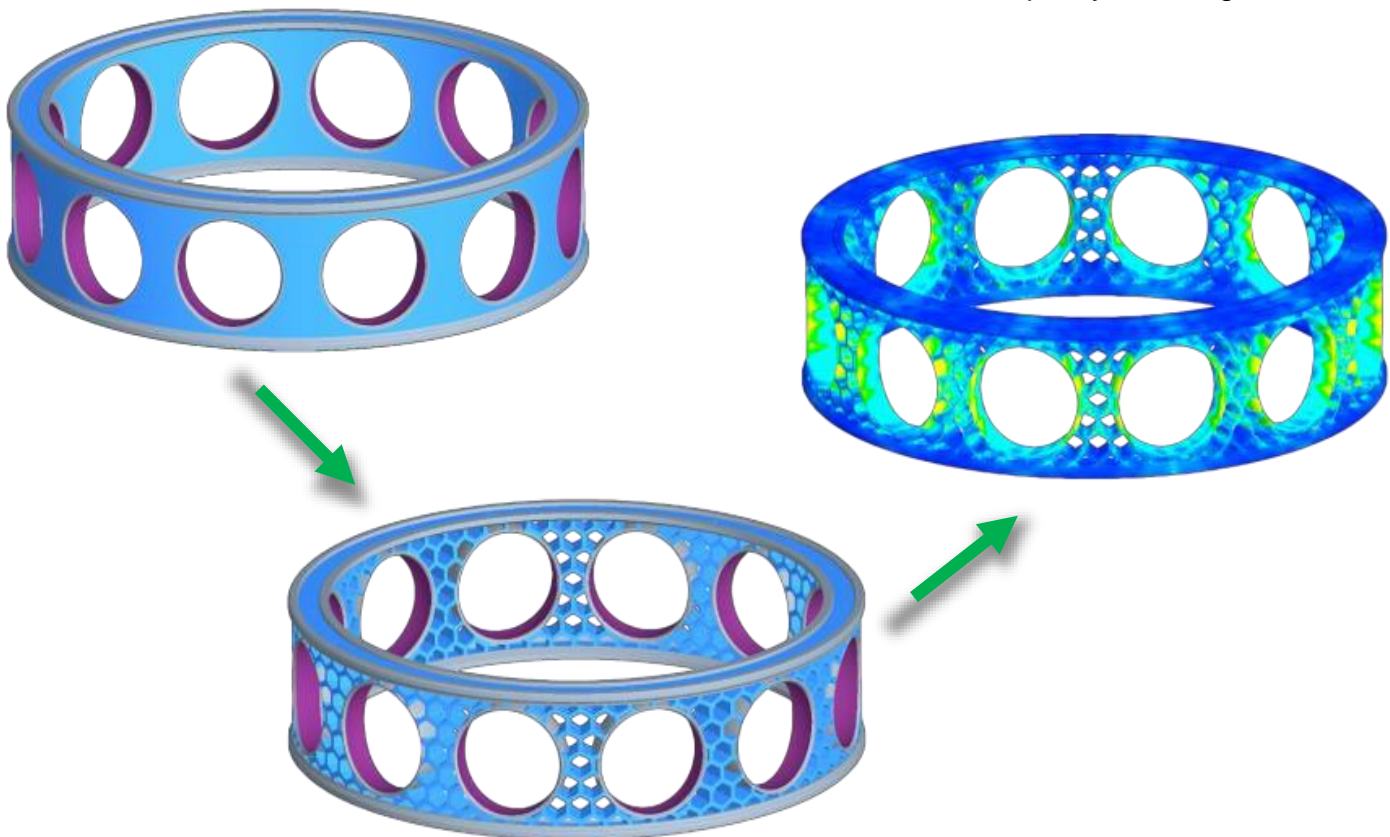


ProTop® / ProTopCl® contains powerful configuration tools. It reconfigures any solid region into a lattice, shell, or mixed structure.

ProTop® / ProTopCl® tools perform this for you numerically - no CAD work is required.

## Lattice structures in ProTop® and ProTopCl®

- Prepare the CAD model of your solid part, in your favorite modeler.
- Apply BCs as usual, to define and complete your FEA model.
- There's no need to carry out CAD modeling of a shell or lattice structure.
- Import your FEA model into ProTop® / ProTopCl® and select the desired lattice pattern.
- Adjust your lattice configuration as desired.
- Create any number of additional (different) lattice configurations, if required.
- Quickly check your design by running ProTop® / ProTopCl® initialization FEA.
- Simply proceed with optimization cycles to improve the design and remove stress concentrations.
- Use ProTop® / ProTopCl® export tools to smooth and export your design.



# ProTop® or ProTopCI®?

ProTop® / ProTopCI® share the same numerical procedures, making them identical in the computational sense. The only differences are related to their import capabilities and interfacing features, as indicated in the following table:

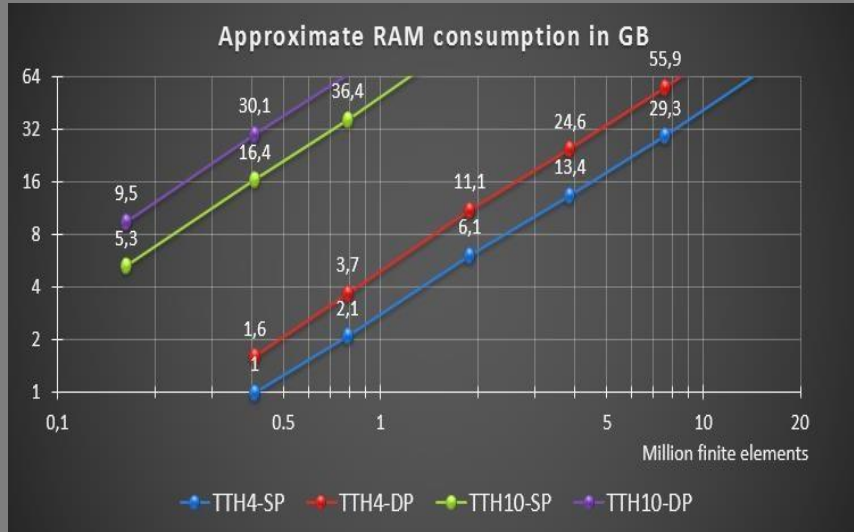
	ProTop®	ProTopCI®
FEA model import from:	<ul style="list-style-type: none"> <li>▪ PTC Creo® FNF file</li> <li>▪ Simulia Abaqus® INP file</li> <li>▪ SolidWorks® Simulation INP file</li> </ul>	<ul style="list-style-type: none"> <li>▪ PTC Creo® FNF file</li> </ul>
Integration plug-in for:	<ul style="list-style-type: none"> <li>▪ PTC Creo®</li> </ul>	<ul style="list-style-type: none"> <li>▪ PTC Creo®</li> </ul>

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Abaqus / SolidWorks is a registered trademark of Dassault Systems Simulia Corporation in the US and/or other countries.

- Specialized custom-coded finite elements
- Hybrid custom-coded evolutionary/level-set optimizer
- High-performance sparse SLE solver
- Only highly parallelized HPC code
- Semi-active element technology
- Smart Start - from functionality
- Interactive load case management
- Special semi-contact elements for efficient contact and fastening modeling
- Special semi-plastic elements for better designs
- Unique shell and/or lattice generation and optimization tools
- Numerical shell or lattice generation from solid models – no additional CAD work necessary.
- Full 3D (solid finite element) lattices - immediately ready for optimization with ProTop® / ProTopCI®

In practical topology optimization, FE models quickly become quite large, because of the need to use rather small elements. Finite element analysis of such models requires a large amount of memory (RAM) to solve the problem in a reasonable time. ProTop® / ProTopCI® are very efficient in terms of CPU Time and RAM consumption, but in spite of that, limited RAM may quickly prevent computing the results efficiently. To get a feeling for approximate RAM requirements, the figure below depicts the situation for a simple test structure, meshed by tetrahedrons (full material design; no void regions).



ProTop® / ProTopCI® offer special technologies to solve very large models extremely efficiently with RAM consumption far below the levels given in the figure above.



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