# ProTOp®   Lattice and Shell Tools

Smart tools for creation and optimization
of advanced structures

Lattice and shell creation from solid models

- Use your favorite modeler to create the CAD model of your solid part
- Add and apply various supports and loads to create various analyses – these will define optimization load cases
- Create the FEM model (meshing, export to a FEM model file)

- In ProTOp®/ ProTOp®CI import the FEM model
- Create numerically various configurations: solid, lattice, shell/lattice
- Any number of configurations can be defined without any CAD modeling
- Individual lattice patterns can be arbitrarily combined by superposition to form more sophisticated patterns

- Check visually your design (cross-sections) to finalize your configuration data
- Adjust and fine tune the parameters (min/max thicknesses, …)
- The full 3D (solid finite elements) structure is immediately ready for optimization
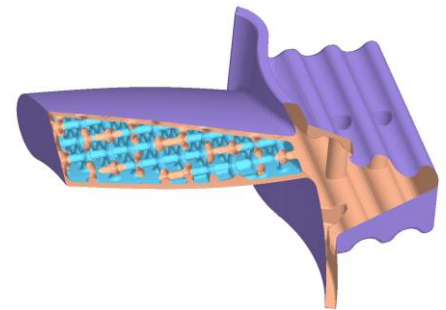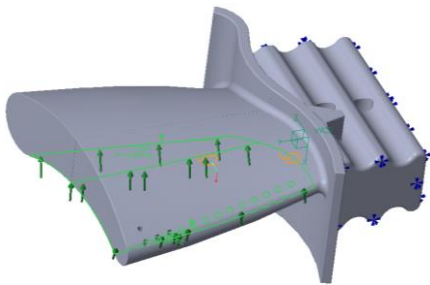

Can the obtained optimal designs be used directly as input for the 3D printing machines?

Yes. ProTOp® contains good surface mesh smoothing and checking tools. Consequently, the exported surface meshes are error free and can be used directly as input for a 3D printer.

# Optimize a full 3D model to make your part durable and failure resistant

- Stress concentrations initiate fatigue cracks which lead to structural failure
- Thus, stress concentrations have to be removed by all means
- This can only be done by optimizing a full 3D model containing solid finite elements

- ProTOp®/ ProTOp®CI tools create full 3D lattice and shell models
- Optimization reshapes lattices and shells (continuously varying thickness) to lower the stresses and remove stress concentrations
- This makes the optimized part resistant to fatigue cracks and failure

- Ideally for development of lightweight and durable load - carrying structures
- Applicable in a wide range from machinery parts to medical implants
- Perfectly suited for new additive manufacturing technologies
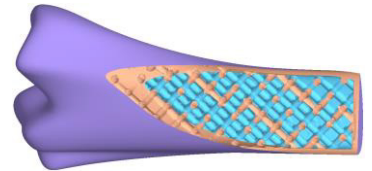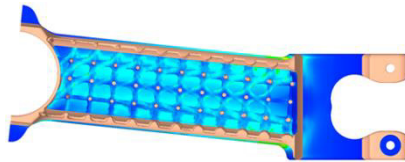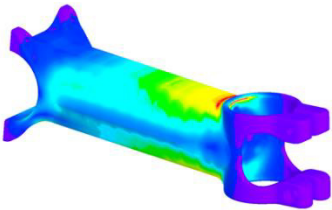
Does the shell or lattice structure of any particular region of the part has to be defined within the CAD program?

No. The CAD model to be imported into ProTOp® is typically a solid structure. Configuring any region of this solid model as a shell/lattice structure is done within ProTOp® by using its configuration tools.
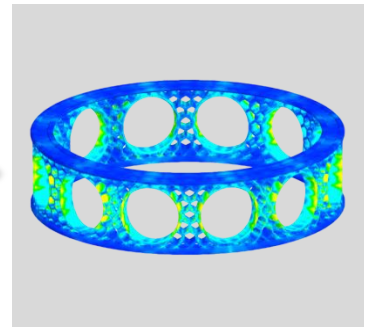
ProTOp® contains powerful configuration tools that can be used to reconfigure any solid region into a lattice, shell, or mixed shell / lattice / solid structure.
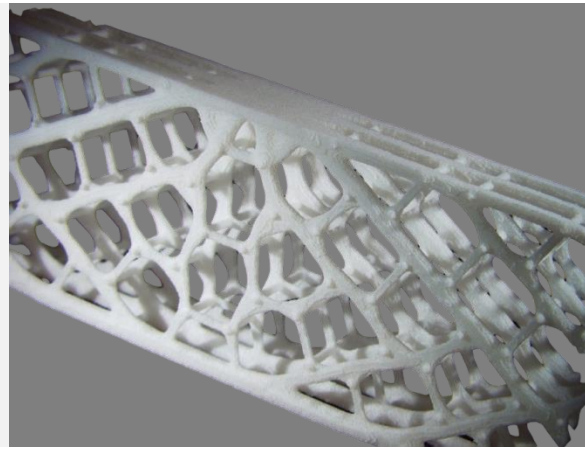
ProTOp® tools do this for you numerically - no CAD work is necessary.

Lattice structures in ProTOp® and ProTOpCI®

- Prepare the CAD model of your solid part in your favorite modeler
- Apply BCs as usually to define and complete your FEA model
- No need to bother with CAD modeling of a shell or lattice structure

- Import your FEA model into ProTOp® /CI and select the desired lattice pattern
- Adjust your lattice configuration as desired
- Create any number of additional (different) lattice configurations if needed

- Check quickly your design by running ProTOp® /CI initialization FEA
- Simply proceed with optimization cycles to improve the design and remove stress concentrations
- Engage ProTOp® /CI export tools to smooth and export your design