
# Parasolid with Convergent Modeling

## Unleash the power of Parasolid B-rep modeling on facetted models

### Benefits

- Incorporate facet data from 3D scanning, topology optimization and other sources into your Parasolid application
- Use a single set of Parasolid modeling tools to create and edit models based on facet data or classic boundary representations
- Eliminate errors and delays when converting between facet and B-rep data formats
- Accelerate reverse engineering processes by enabling design modifications on facetted models derived from scan data
- Directly edit facetted 3D models for additive manufacturing

### Summary

Two distinct technologies are commonly applied in the definition of digital 3D models. Boundary representation (B-rep) modeling is the preferred solution for engineering. Most applications in design, simulation and manufacturing use this technique, where the shape of the model is defined by mathematical curves and surfaces.

Facet modeling is the preferred approach for applications such as gaming and animation, where optimal performance can be achieved using less precise model representations. Facet models use a mesh of connected planar polygons to define the surface of a 3D model.

Convergent Modeling™ technology is the breakthrough in 3D modeling that seamlessly brings these two techniques together in Parasolid® software. The Parasolid B-rep model representation is extended to include facet mesh as a new surface type that can be operated on by all existing functionality. As such, facet meshes are fully integrated into the core model and not a parallel representation.

### The proliferation of facet data

Facet meshes are becoming more common in engineering workflows that were designed to work with B-rep data. The proliferation of facet data is being driven on several fronts:

- *3D scanning* – More digital models are being created from the real world using optical/laser scanners. Applications include industrial reverse engineering, as well as medical imaging to create artificial implants and orthopedic structures that are a perfect fit for the recipient. 3D scanners typically sample the physical object as a cloud of points which forms the basis of a facet mesh.
- *3D printing* – the manufacture of custom, complex shapes that are difficult or costly to manufacture using traditional methods typically uses facet data formats, for example 3D Manufacturing Format (3MF) and stereolithography (STL).
- *Topology optimization* – during product design, the shape of a 3D part can be automatically optimized for mass, strength and other parameters based on user-defined constraints, such as a bounding region for the part, the location of its attachment points and the forces acting through them. The result is often a highly organic shape that has a facet representation.

### Importing facet meshes in the design process

Facet meshes associated with the above processes are often brought into engineering design environments that operate on B-rep models. For example, it may be necessary to modify the facet

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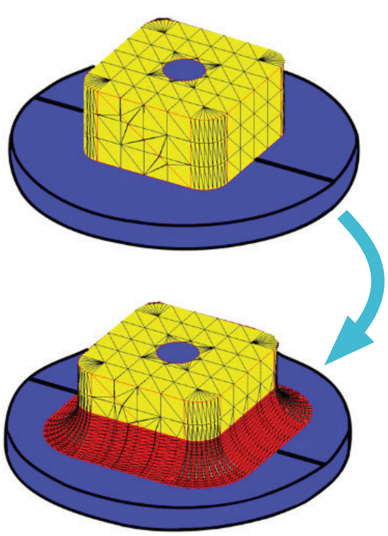
**Features**

- Advanced modeling operations on facet models, including full Boolean functionality, extrusion, offsetting, hollowing, thickening and blending
- Facet modeling support functions include unite, subtract and intersect operators, imprinting, sheet trimming and extension, profile sweeping and spinning and patching of holes in 3D models
- Facet model interrogation and computation functions, including geometric evaluations, mass properties, minimum/maximum distance and clash detection
- Selected operations can be applied to facetted surfaces and classic surfaces that co-exist in the same model
- Facet mesh import tools including data repair and optimization
- Create facet models from classic B-rep bodies
- Create classic trimmed surfaces directly from a mesh



Using Convergent Modeling to blend a mixed model.

model using more sophisticated B-rep modeling tools, or to integrate facet data sources with B-rep components in a single model. In such cases, it is necessary to convert the facet data into the B-rep format. This translation process can be complex, time consuming, and prone to errors, especially when converting complex shapes.

Parasolid with Convergent Modeling enables 3D product modeling on both data sources in a single environment, while eliminating the complexity, error and delay of converting on-the-fly between the two formats.

## Facet modeling with Parasolid

Over the last 30 years, a vast set of classic B-rep modeling tools has evolved in Parasolid and enhancements to these functions continue in parallel with new developments in facet modeling. Almost all B-rep modeling functions have been redeveloped for use on facetted models.

Furthermore, Convergent Modeling supports an increasing range of operations that can be applied to facetted surfaces and classic surfaces that co-exist in the same model, including operations where the two formats interact. For example, a fully facetted model can be sectioned with a plane, or Booleaned with a cylinder to create a through hole that creates a model with a mixture of classic and facet surfaces in each case.

With each new Parasolid development cycle, facet modeling capabilities are extended and tested to ensure the high quality and performance our customers demand.

The end goal is to enable all Parasolid functions to be used on arbitrary combinations of classic B-rep and facet geometry in the same model.

To support the integration of facet data in the Parasolid modeling environment, numerous utilities are provided for working with facet meshes, including:

- Adding imported mesh data to facet B-rep bodies
- Repairing imported meshes; correcting folds and slits, filling holes, etc.
- Knitting meshes together
- Creating facet B-reps directly from classic B-reps with user-defined precision
- Creating classic trimmed surfaces directly from a mesh

## Openness and design freedom

Siemens Digital Industries Software has a well-established culture of vendor openness. A key characteristic of openness is support for data interoperability. This enables end-users to share, edit and re-use 3D models created using different formats across different workflows and applications.

Integrating facet and B-rep modeling in a single modeling engine opens workflow barriers for such end-users. Parasolid is openly licensed to all software vendors so that more end-users can seamlessly access facet and B-rep model representations, regardless of their choice of application.

Making Parasolid openly available, even to competitors, demonstrates our genuine commitment to openness. Parasolid with Convergent Modeling is used in our own applications, such as NX™ software and Solid Edge® software. Software vendors who license Parasolid receive exactly the same software at the same time with the same support.

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