Solid-Surface Hybrid Modeling: Future Trends of 3D CAD Modeling

ZW3D CAD/CAM White Paper

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Overview

With the innovation of computer aided design technology, it is easier than ever to express the world three-dimensionally. The technology of 3-demensional modeling is ever-developing with diversified modeling approaches like wireframe modeling, solid / surface modeling, feature modeling and synchronous technology. ZW3D CAD/CAM software presents users with solid-surface hybrid modeling technology, developed on the foundation of ZW3D kernel - Overdrive^{TM}, resulting in great 3D CAD modeling flexibility.

Table of Contents

1. Introduction of Solid Modeling And Surface Modeling

Solid modeling and surface modeling are two kinds of geometric modeling methods in three dimensions. Solid modeling (see Figure 1) is distinguished from related areas of geometric modeling by its emphasis on physical fidelity, the representation of the solid parts of the object.
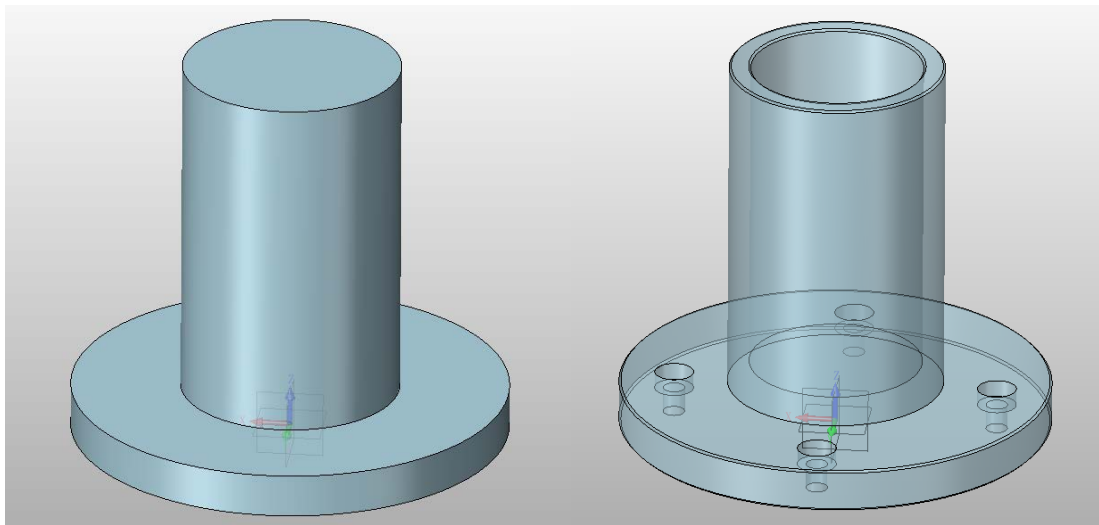

Figure 1 solid modeling

Surface modeling (see Figure 2) is a mathematical modeling technique used to define an object's exterior with an infinitesimally thin skin.
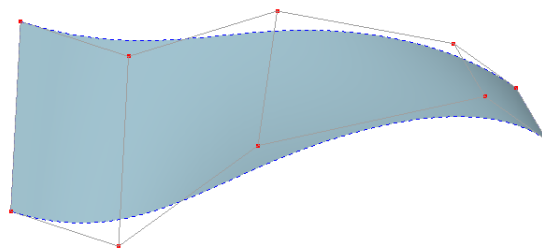

Figure 2 surface modeling

Solid modeling represents an object unambiguously by describing its surface boundary and topological orientation so that we can tell at each surface point, on which side the solid interior lies. Surface modeling, in comparison, only gives a geometric description of the object boundary without any topological information.When it comes to the creation of

high-qualified complex surfaces, however. surface modeling can definitely beat solid modeling.

Over the years, ZW3D has been working on integrating surface and solid modeling to take full advantage of the traits of these two modeling technologies. With the birth of ZW3D kernel, Overdrive^{TM} , the solid-surface hybrid modeling technology enables users to design freely between solids and surfaces.

For most 3D CAD software, designers use surface to cut shapes (see Figure 3). Is it possible to cut shapes with solid? Using solid-surface hybrid modeling, this can happen, as shown in Figure 4.
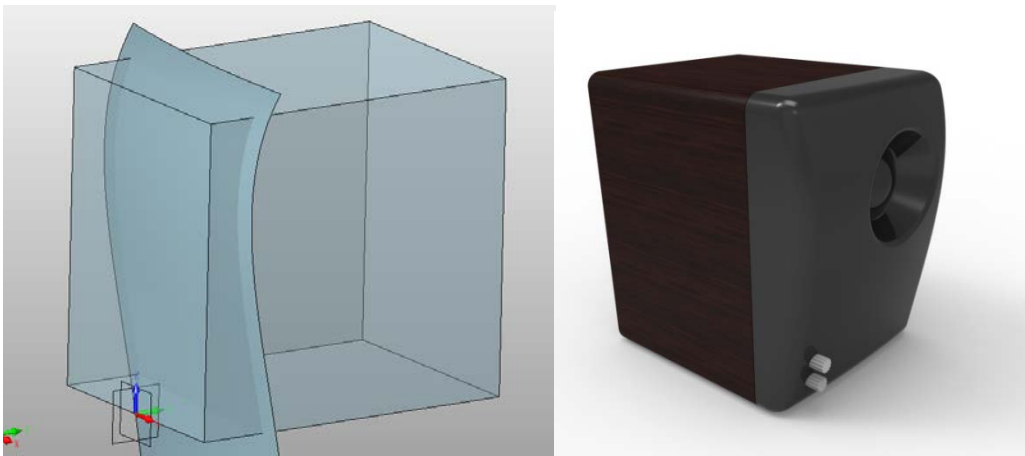

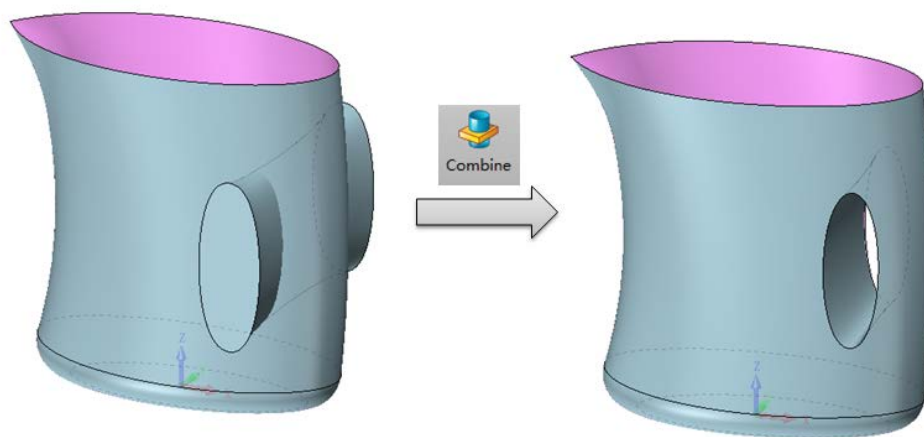Figure 3 cutting shapes with surface

Figure 4 cutting shape with solid

2. Introduction of Solid-Surface Hybrid Modeling

Users don't need to care if the object is a solid or a surface because most of the commands can be used for both solids and surfaces. Previously, users had to be trained to distinguish the difference between solid modeling commands and surface modeling commands, which made 3D modeling usable to only professionals. However, solid-surface hybrid modeling can eliminate this barrier between solid modeling and surface modeling, providing much more user-friendly 3D modeling.

Take the calculation of mass property for example. Solid modeling can only calculate the mass property with a perfect solid which has no gaps at all. With solid-surface hybrid modeling, however, ZW3D can easily work this out no matter the amount of gaps on solids. It's common to get imperfect models while importing a different file format. Normally, designers have to spending lots of time healing models before getting the mass property, whereas ZW3D's solid-surface hybrid modeling can save designers from tedious repairing work to focus on more creative tasks.
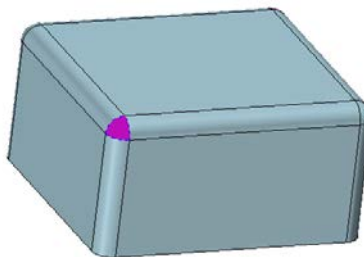
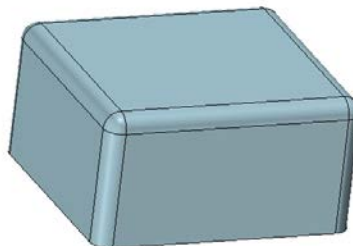Figure 5 hybrid modeling can handle but solid modeling can't

Figure 6 both hybrid modeling and solid modeling can handle

True solid-surface hybrid modeling can change your opinion about solid modeling and surface modeling, once you accept it; it can make a huge change to your work.

3. Application of ZW3D's Solid-Surface Hybrid Modeling

3.1. Mold Design

In this information age, the source spreaders like TV, phones and laptops become basic necessities in daily life. To produce these products in bulk, mold design is an indispensable production procedure. While designing mold, the splitting of Core and Cavity is one of the most challenging techniques, requiring well-trained skills as well as significant amounts of checking and healing work. The splitting becomes even harder when the solid is not perfect in the solid modeling or surface modeling kernel. It's a nightmare for mold design companies, who receive different file formats to make a mold. Mold designers have to work day and night to assure the quality of imported parts and their compatibility with solid modeling or surface modeling.

All these troubles of mold design can be terminated by using the solid-surface hybrid modeling technology of ZW3D, most of whose commands can work seamlessly between solids and surfaces, greatly simplifying mold splitting. As shown in the following pictures, designers can quickly split the mold with gaps to core and cavity thanks to the solid-surface hybrid modeling.
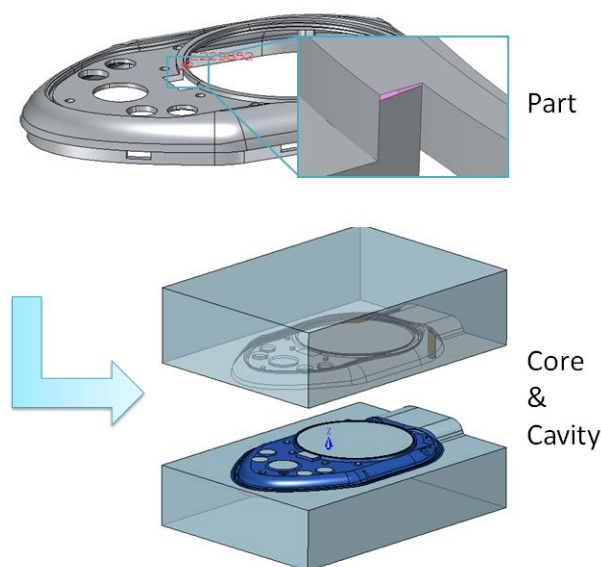
Figure 7 splitting a gapped mold with hybrid modeling

3.2. CNC Machining

An essential step of turning designs into real products is manufacturing, where CNC machining is widely used. Traditionally, the CNC manufacturing process requires experienced CNC programmers. To simplify CNC programming, more and more innovations have been involved, including smart tactic, automatic machining, and many more; however one step that can never be skipped is dealing with external files in programming before you use any smart machining method.

Let's take the machining of a part for example (Figure 8). While CNC machining, the tool-path needs to skip gaps, slots or holes, but most CAM software can't recognize these geometric features, requiring designers to heal or create new assistant surfaces to close them one by one. If the part has a lot of slots, holes or small gaps, designers will have to spend days just on healing. This will not happen in ZW3D. Based on the solid-surface hybrid modeling technology, ZW3D can recognize these geometric features of the solid and non-solid parts. Thus, the tool can cut parts while automatically skipping holes or gaps, saving designers a great amount of time. Moreover, during programming and solid simulation, tool path checking works the same for both solids and non-perfect solids.
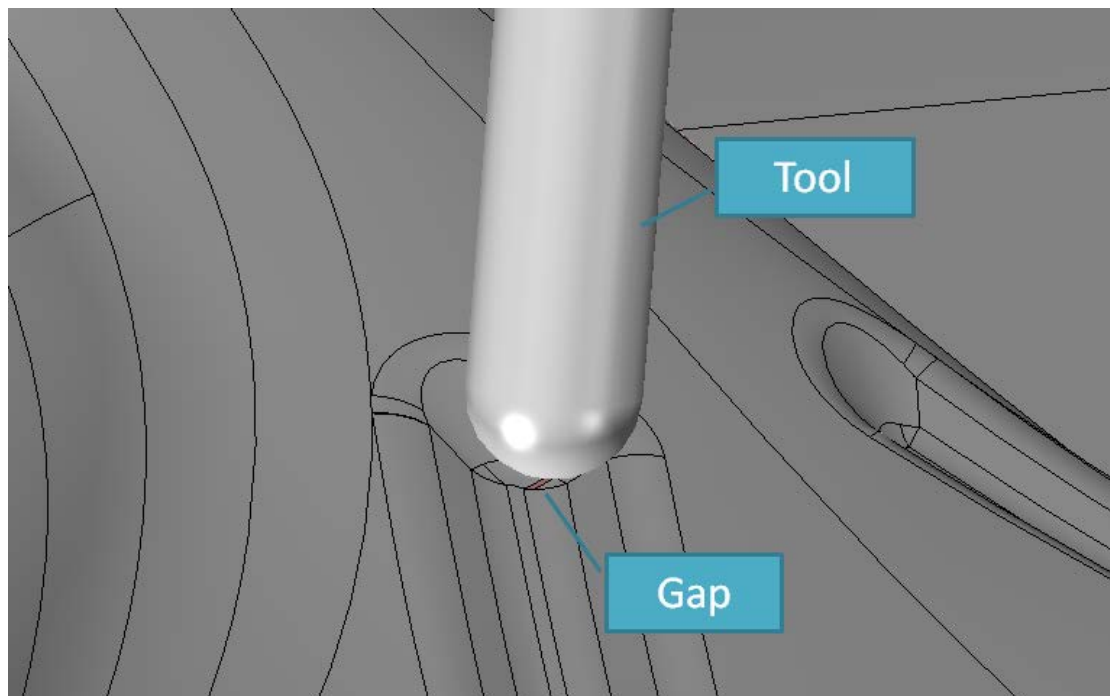

Figure 8 Tool skipping the gaps

Solid-surface hybrid modeling is not just a feature. It is the kernel technology which is involved in all the features you might use every day. With this technology, designers won't

have to consider whether they are dealing with solids or non-solids, therefore simplifying the whole manufacturing process.
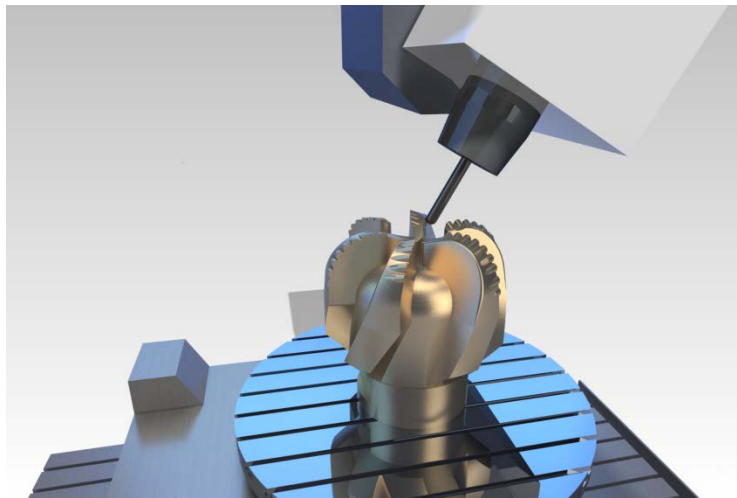

Figure 9 CNC Machining

3.3. 3D Printing

After decades of research and development, 3D printing technology is finally becoming a mature technology, inspiring people to print unique and meaningful products. To spread 3D printing technology to users without a professional CAD/CAM background, Microsoft has developed the basic 3D printing feature in Windows 8.1, but that is not enough. If users want to design 3D models, there should be some easy-to-use tools or user-friendly apps helping them to design models. Of course, the tools or apps must be designed for Windows 8 with a Stylish Ribbon interface to simplify the design. That's what solid-surface hybrid modeling technology does, allowing greater flexibility. With no need to capture complicated concepts like solid modeling or surface modeling, designers can use the same fillet command to add a fillet to the solid or surface and erase the face of the solid model to convert it into a surface. All commands work very natural.
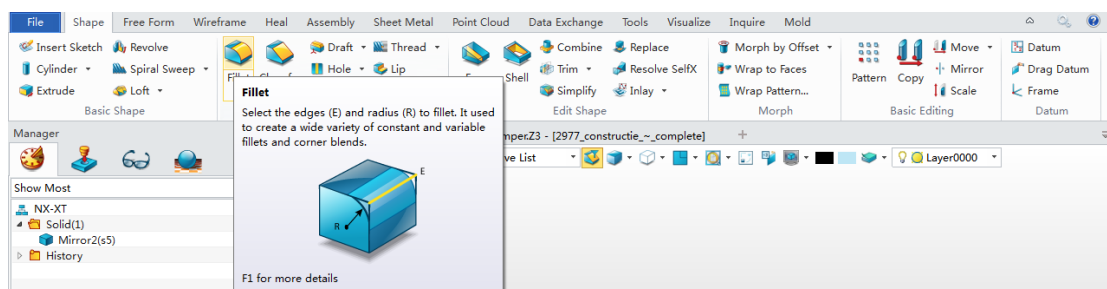

Figure 10 stylish Ribbon interface

3.4. Professional and Complex Design

With solid-surface hybrid modeling, the Boolean operation works for both solids and surfaces, enlightening your imagination during the design process. For the kind of complex design, as shown in the picture, it is not easy to modify by only surfacing, but hybrid modeling works with only one Boolean operation.
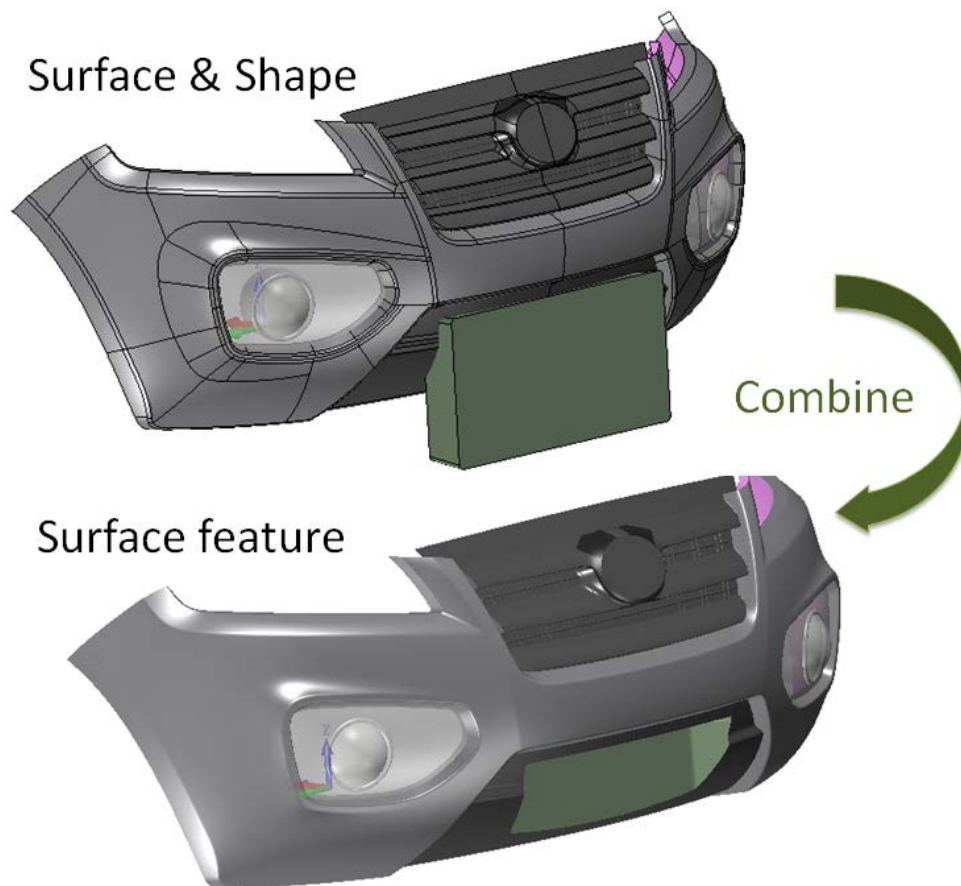

Figure 12 Boolean Operation by using solid to combine the surface

Based on the Overdrive™ kernel in ZW3D, the solid-surface hybrid modeling can be extended to other operations for easy design. For instance, morphing is more powerful, while transforming the shape and wrapping becomes diversified since any geometry, such as a solid or surface, can be glued to a model. The hybrid modeling technology possesses the power to eliminate the barrier between solids and surfaces, which empowers lots of incredible functions for professional design.
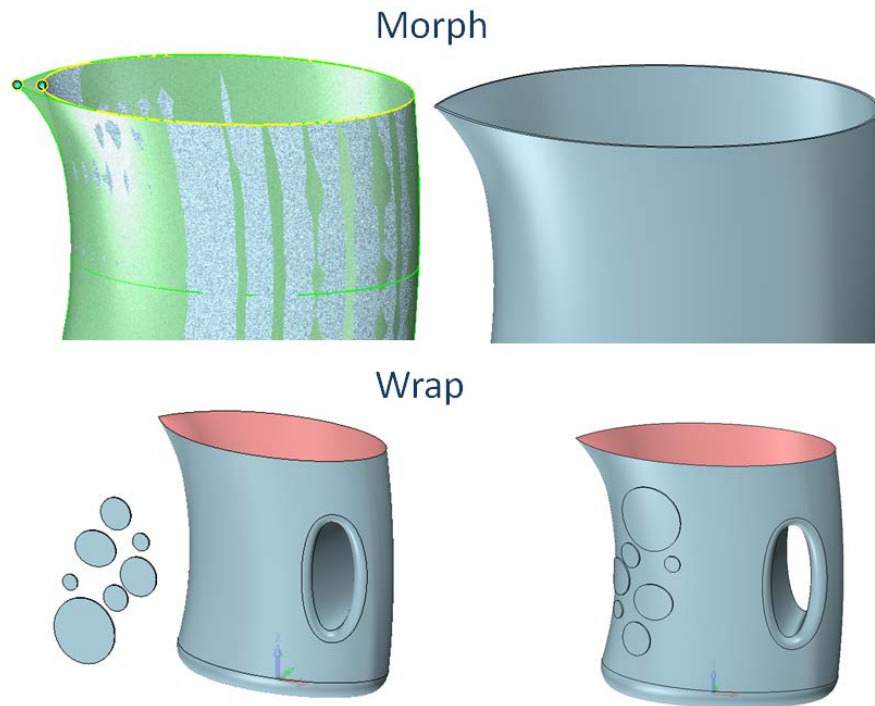
Figure 12

4. Technology trend of 3D modeling

Besides the capabilities to deal with product design and mold design like solid modeling and surface modeling, solid-surface hybrid modeling provides more possibilities to do something that neither solid modeling nor surface modeling can do. Today, we are facing more design challenges as people have higher expectations of design. The innovation of solid-surface hybrid modeling can empower your imagination and overcome those design challenges. No matter what industry, dealing with files cannot be neglected, and it is this area where solid-surface hybrid modeling technology helps a lot.

In the future, absolutely, there will be more and more technologies invented to overcome design challenges and help users to focus more on design creativity, but 3D modeling technology is the foundation; solid-surface hybrid modeling technology is the perfect combination of solid modeling technology and surface modeling technology which will affect future design trends.