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## The Direct Modeling Approach to Parametric Changes

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Today's designers demand speed and efficiency from their MCAD tools. The competitive nature of business, both domestically and abroad, as well as the abundance of skilled labor mean that it is no longer about just being the best. Now, it is just as important to be the fastest and the most efficient. In a game in which keystrokes and mouse-clicks can be seen as dollars ticking by, any advantage which increases designer productivity is invaluable.

Designers want to use the most powerful software available. With each upgrade of Unigraphics NX, SolidWorks and Pro/Engineer modelers, it becomes imperative for users to capitalize on the most recent innovations and technologies. Missing out on new functionality could mean doing something "the old way", instead of a cleaner, more efficient procedure.

The best Computer Aided Design (CAD) system should be as unobtrusive as possible; meaning that the engineer should be able to concentrate on the actual design and not the working or programming of the CAD system. For many years now, a main focus of many of the leading CAD vendors has been increasingly powerful parametric capabilities. This has brought us amazing new capabilities in our CAD. But, there is a new class of capabilities that promises to be no less than a revolution in CAD. This is called "Direct Modeling." Direct Modeling is to solid surfaces what geometric constraints were to lines, arcs, and splines when it was first introduced years ago. It is one of the most important innovations in CAD modeling, equivalent to parametric functions on steroids.

NX Direct Modeling enables you to alter the geometry of an existing feature (ie. hole, boss, etc.) and tie it to a new variable that you create. The Direct Modeling functionality works regardless of the feature's construction technique. It is particularly useful when working on imported geometry with no parametric feature data (IGES, STEP, etc.). For example, a "Resize Face" is created on the surface of a hole which overrides the original definition. The resultant feature now has a diameter that is controlled by one expression, which can then, in turn, be linked to anything else. Direct Modeling features can be applied to any features of a part, not just holes!

The NX Direct Modeling options include:

- Local Scale
- Constrain Face
- Resize Face
- Offset Face
- Replace Face
- Move Region

- Pattern Face
- Reblend Face
- Simplify

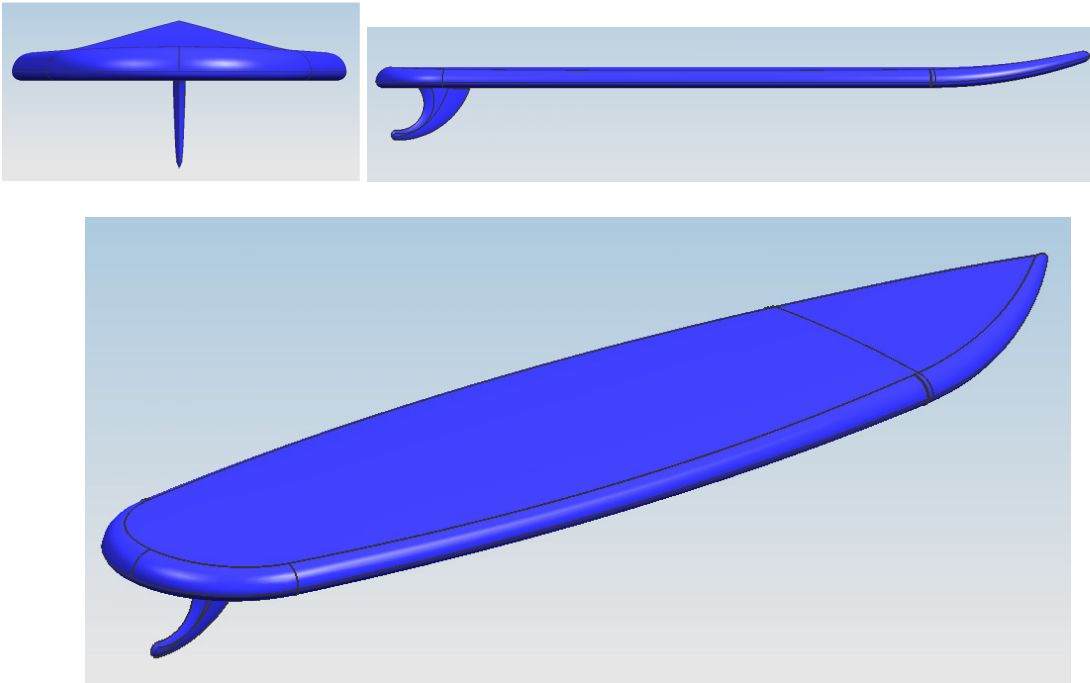


Figure 1

Figure 1 illustrates the geometry model of a simple surfboard with a raised fin near the back. We use a simple model here to illustrate functionality; however, Direct Modeling tools can be applied to more complex models with amazing results!

It should be emphasized that the original modeling history used to create this geometry is completely irrelevant to Direct Modeling. Direct Modeling allows geometric manipulation that is independent of any creation technique—a break from traditional parametric modeling systems.

First, let's examine the "Move Region" command, which allows a user to select any number of surfaces and apply a number of discrete tweaks.



Figure 2

In Figure 2, we see that the surfboard fin is rotated 30° about an axis located at the front of the fin. The rotation of the hole axis was created using "Move Region" in NX3's

Direct Modeling menu. The fin angle can be modified after the fact, adding parametric qualities to an otherwise non-parametric feature.

“Move Region” has the ability to do far more than rotate a feature about an axis.

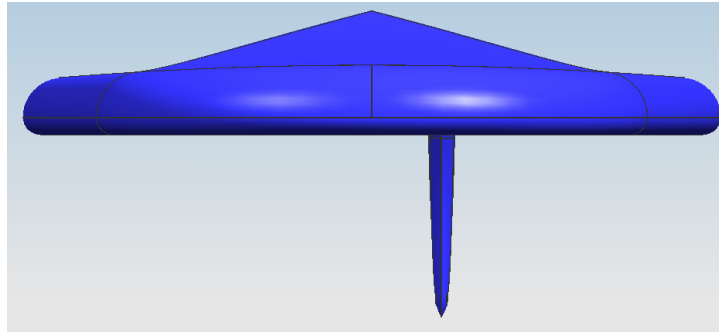


Figure 3

In Figure 3, the “Move Region” command was used to move the tail fin 2 inches to the right. In this example, after the features were selected, NX allowed us to move them in any direction chosen.

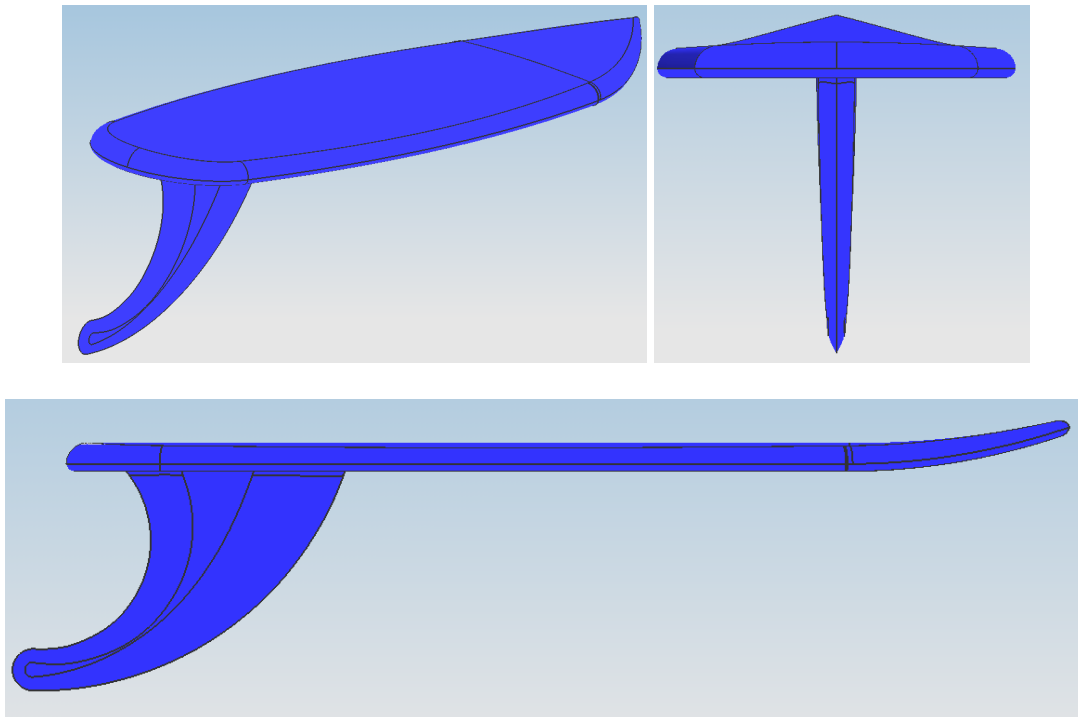


Figure 4

Now, let's examine how to use Direct Modeling. First, start with the simple surfboard model from Figure 1. This time, the fin has been completely resized in relation to the rest of the surfboard. The Direct Modeling “Local Scale” command enables you to resize the fin by a factor of 3. The rest of the geometry, unselected in the “Local Scale” command, retains its original characteristics. A reference point for “Local Scale” was needed; this time it was where the back of the fin contacts the surfboard.

Direct Modeling “Local Scale” can be helpful when designing parts where thermal expansion must be taken into account. It also gives you the power to select a group of surfaces and apply a uniform or non-uniform distortion to them. An example of why this might be useful is that of casting distortion. In many cases, people who design castings deal with the fact that shrinkage is non-uniform. Direct Modeling can be used to apply “falsifications” to their solid models in anticipation of the shrinkage. The result is a far more accurate model.

Another example of Direct Modeling is the very powerful “Simplify” command.

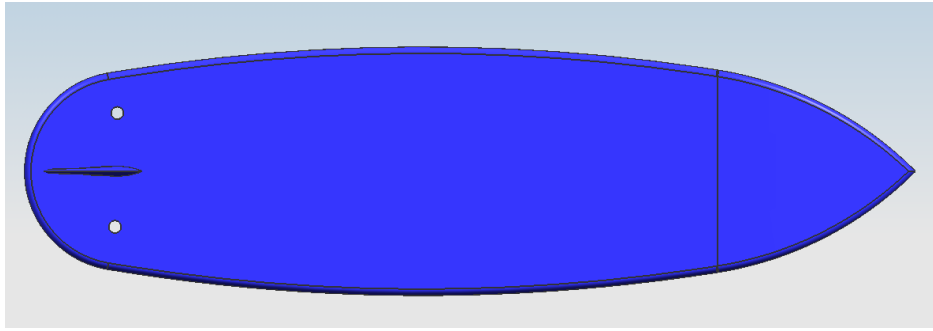


Figure 5A

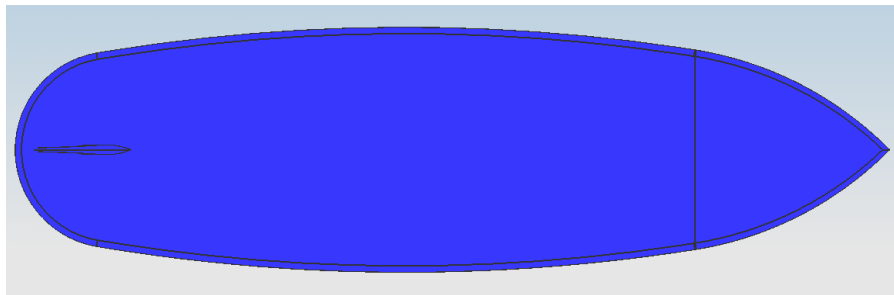


Figure 5B

Figure 5A shows the surfboard with holes along the length. Using the “Simplify” command, NX allows us to choose to simplify, or remove, any holes under a specified diameter. With an input diameter of 2 inches, the “Simplify” command removes the holes, as shown in Figure 5B.

In summary, Direct Modeling:

- Is parametric.
- Allows you to override what has been done before.
- Saves you the trouble (and sometimes torture) of deciphering over-complex list of features.
- Allows you to think like an engineer as opposed to a programmer.
- Allows you to parametrize previously non-parametric models.

Direct Modeling can result in many benefits for design teams. It can save considerable time; it requires little or no training; it does not require a sophisticated user. The feature workflow in Direct Modeling is designed for casual users of Unigraphics.

And remember, Direct Modeling is only available in Unigraphics NX!