

Reverse Engineering

Pro/ENGINEER Wildfire continues to provide new technology to support the product design and development process by introducing Restyle. Restyle enables engineers to create accurate, modifiable Pro/ENGINEER models from 3D scan data quickly while capturing design intent and maintaining critical geometric data that is often needed downstream in the design process. Today's reverse engineering solutions tend to lose any design intent that may be included in a surface quilt. For example, imported surfaces may be tangent at the adjacent boundaries but these attributes are lost on import so they will not be recognized by downstream applications. Not only will Restyle capture critical design intent but this is accomplished inside of Pro/ENGINEER ensuring any subsequent changes are seamlessly propagated throughout the design.

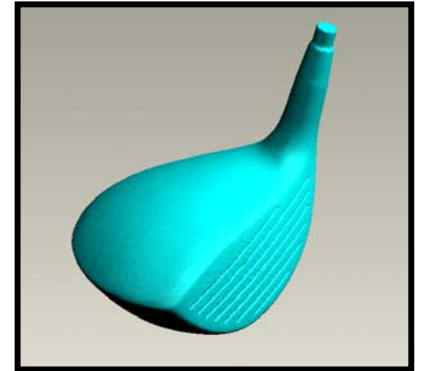


Figure 1-Facet Model

Current Situation

Reverse engineering has typically been a very expensive and labor-intensive venture. Never before have there been so many complex products or products to service.

A company may desire to manufacture peripherals for products whose digital data and specifications are not released by the manufacturer. The complete redesign of the product may be out of reach technically or the project may prove to be prohibitively expensive to embark on if the technical expertise must be developed. What is needed is a tool that can capture the valuable design intent of the original product.

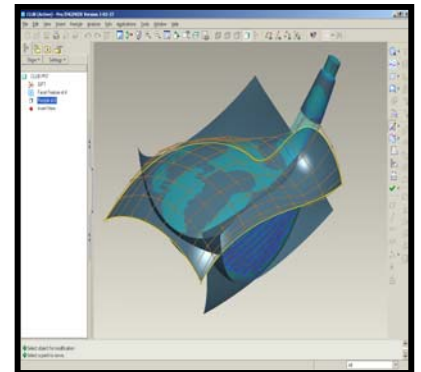


Figure 2-Quick Pick Surfaces

The medical device industry is faced with the challenging task of designing manufacturable products that fit together with the human body. Not only is accurate engineering data not available for the design but each individual is significantly different. Acquiring a digital representation of the mating parts and designing around them would be an extremely desirable approach to the problem as it would ensure a perfect fit. Both of these situations and countless others pose a significant challenge to engineers that must be overcome in an effective cost efficient manner.

Obtaining the Competitive Advantage Using Restyle

Many companies have some of their most successful products represented in a physical medium only. These physical representations do not have the flexibility to be modified or improved quickly and efficiently and because of this suffer major losses in productivity. Designing an existing product from scratch or spending wasteful time on unnecessary design iterations is undesirably to

say the least in today's market place. PTC has recognized the need for a product that not only creates high quality surfaces from scanned data but that also significantly automates the process. This simplifies the workflow, reduces training time and allows the designer to focus on the task at hand. PTC has introduced a solution to this challenge for the Pro/ENGINEER Wildfire release called Restyle.

Restyle allows customers to reverse engineer or design products to fit existing physical models as well as thrive in industries where mass customization is required. Restyle has combined the proven technology from Raindrop Geomagic with PTC's world class CAD tool. What has emerged is a reverse engineering solution that significantly automates the complex process of transforming scan data into manufacturable surfaces while capturing design intent.

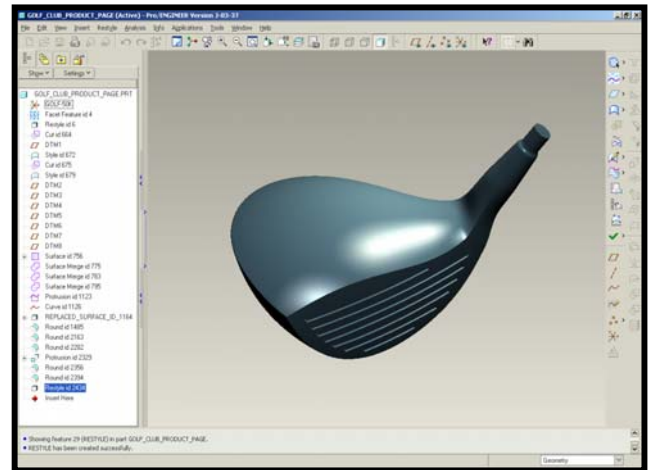


Figure 3-Surface Construction

Restyle contains cutting edge tools to work with and refine point cloud and polygonal data ensuring optimum results in subsequent phases of the process. These tools reduce noise and/or the total number of points to speed up processing time without sacrificing the level of detail in the original design model. Triangles may be deleted or refined in order to eliminate any error that may have occurred during the wrapping process without compromising surface integrity or detail.

Once an acceptable facet model has been created quick pick simple surfaces such as cylinders and cones or complex surfaces can be created with ease. Surfaces can be projected to fit facet data or boundary surfaces created from curves sketched on the facet model. Once a surface is created the full set of Pro/ENGINEER analysis tools are available for surface analysis and to check for any deviation between the surface and facet model. Surfaces may also be edited to change such properties as surface type (ex NURBS/BAZIER), U/V parameters etc. Surfaces may also be manually manipulated in a free form or numerical manner for fine-tuning the final model. The result is a fully modifiable, highly customizable Pro/ENGINEER surface representation of a product that fits right the first time.

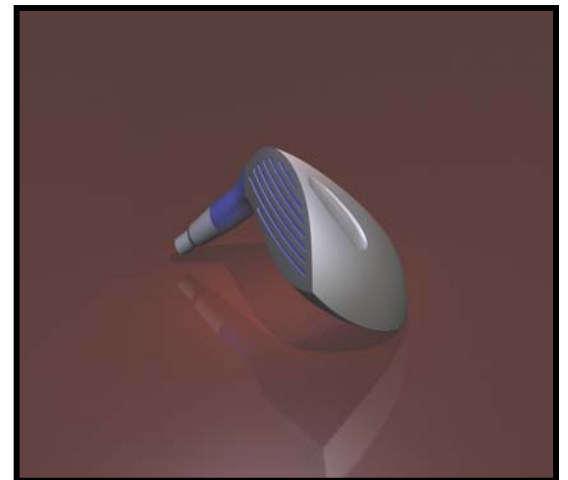


Figure 3-3D Pro/ENGINEER Solid Model

The advanced functionalities of the Reverse Engineering Include:

Point Cloud Refinement

- Point cropping
- Noise reduction
- Automatic deletion of outlying points
- Point sampling (Random, uniform and curvature sampling)
- The ability to fill holes in scanned data

Curve Creation

- Curve on facet
- Curve on surface
- Section
- From Edge
- Analysis Extremum
- Analysis Isoline
- From border
- From sharp edges
- Through points

Surface Creation

- Plane
- Cylinder
- Cone
- Revolution
- Extrusion
- Four curves rectangle
- Three curves triangle

- Surface from net
- Three curves rectangle
- Surface from box
- Four points rectangle
- Four points cross
- Two curves rectangle
- N curves loft

Facet Modeling

- Automatic removal of webbing
- Removal of facets as singles, groups or user defined cropping
- Facet filling operations
- Cleaning operations
- Decimating operations
- The ability to refine facets
- The ability to relax facets
- Make manifold operations