

Closing the Reverse Engineering Loop: Laser Scanning as the Bridge from Legacy Part to CAD to CNC Machining

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Background

Reverse engineering is the process of creating a digital computer model from an existing physical object that might be too difficult to reproduce directly on the computer screen in a computer aided drawing (CAD) package. In the past, parts were measured by hand and computer models created that attempted to closely resemble the part. Current techniques in laser scanning parts have greatly improved this process; no longer must the engineer physically touch the part to capture its size and shape. If the intention is to create a part that can be machined, the challenge becomes to create a work flow that results in a model recognizable by the programming software (CAM) used to control the machine tools.

Purpose

The goal is to produce open source CNC model workflow documentation that can be shared within the scanning community of users. Scanner manufacturers have made these devices attractive to schools and colleges, but little information exists on how to use the systems effectively for CNC preparation.

Design/Method

A range of parts were created in Solidworks, 3D printed, and then scanned for reverse engineering practice. They were designed to define operational limits to see how well objects could be scanned for eventual machining .

Results

Laser scanning using the NextEngine scanner provided reliable scan and 3D mesh files on most parts. Sufficient data to describe the geometry can be obtained, although multiple scans might be required to reach undercuts and hidden areas.

Watertight models for 3D printing are easy to achieve, while models for CNC programming are a greater challenge. Automatic surfacing worked to create a “dumb solid” such as a STEP or IGES file. However, this often results in complex small surfaces requiring 3D toolpaths, even on surfaces that should have been a flat plane. The best results were obtained using Rapidworks for generation of parametric models derived from the scan data. This is an add-on to the NextEngine scanner. However, adequate results were obtained using the Scan-to-3D add-on included in the student version of Solidworks. This feature allowed Solidworks to import the scan data directly, which could then be used to create planes and surfaces for the creation of solid geometry for easy programming.

Conclusions

Laser scanning for reverse engineering to CAM proved to be an effective process, with the final results dependent on the techniques selected to process the mesh. Two useful methods were found, with Solidworks Scan-to-3D being the widest choice available to students.