Chapter 4

Reverse Engineering: A Review & Evaluation of Non-Contact Based Systems

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Abstract

This chapter will define the concept of reverse engineering systems that are typically utilized in design and manufacturing environments. We will also develop a taxonomy of reverse engineering systems. Differences between contact and non-contact methods for reverse engineering will be detailed. Commonly used non-contact systems, including active and passive systems, will be detailed. Our focus will be on techniques such as laser scanning and 3D cameras.

Key words

Reverse engineering, non-contact, CAD, CNC, taxonomy, active techniques, passive techniques, laser scanning, STL format, CAM, photogrammetry, CCD, MRI, computed tomography, ultrasound scanning, medical image data file, ACR/NEMA, DICOM3, three-dimensional reconstruction, rapid prototyping

4.1 Introduction

Reverse engineering, widely noted as an effective cost saving tool, is a systematic approach used to analyze the dimensions, contours, and design of an existing device so that one may derive potential improvements to the device or perform competitive benchmarking to further understand the product. While reverse engineering is typically used as a manufacturing "aid," the resulting information contributes to product evolution, either at the subsystem, configuration, component, or parametric levels, that will occur through redesign processes.

The origins of reverse engineering are largely unknown. Rather than having been developed at a specific period or moment in time, the concept of reverse engineering arose in an evolutionary manner. It began as a way to "build a better mousetrap." As a design was developed, it would be critically assessed, examined, changed, and thus the design would inevitably be improved. Today reverse engineering is used not as a tool to be employed to an existing problem, but as practical methodology to new challenges of unique parts (with no design or developing computer drawings/molds of parts and tools where none exist).

Reverse engineering has been described as "a four-stage process in the development of technical data to support the efficient use of capital resources and to increase productivity"[6]. These stages are:

- Data evaluation – visual inspection, dimensional inspection, quality evaluation, possible failure analysis
- Data generation – engineering drawings, CAD models
- Design verification – prototyping, model testing, model failure analysis, quality assurance
- Design implementation – prototype delivery, project summaries, economic analysis, final implementation

Reverse engineering serves as a starting point in the product redesign process, during which the product is analyzed in terms of its functionality, physical principles, manufacture-ability, and assemble-ability, for the purpose of fully understanding every detail of the product. However, to begin the reverse engineering sequence, accurate geometric data from the surface of the existing part must be obtained.