Chapter 6

VIRTUAL ASSEMBLY ANALYSIS ENHANCING RAPID PROTOTYPING IN COLLABORATIVE PRODUCT DEVELOPMENT

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Abstract:

This chapter discusses how assembly operation analysis can be embedded transparently and remotely into a service-oriented collaborative assembly design environment and how the integrated process can help a designer to quickly select robust assembly design and process for rapid manufacturing. A new assembly operation analysis framework, relevant architecture, and tools are introduced. True competitive advantage can only result from the ability to bring highly customized quality products to the market at lower cost and in less time. Product development has become a very complicated process. Many customers are no longer satisfied with mass-produced goods. They are demanding customization and rapid delivery of innovative products. Industries now realize that the best way to reduce life cycle costs is to evolve a more effective product development paradigm using the Internet and web based technologies.

Yet there remains a gap between these current market demands and current product development paradigms. The existing CAD systems require that a product developer possess all the design analysis tools in-house making it impractical to employ all the needed and newest tools. Instead of the current sequential process for verifying and validating an assembly design concept, a new Virtual Assembly Analysis (VAA) concept is introduced in this chapter to predict the various effects of joining to realize a rapid manufacturing environment. The predicted effects provide very important decision information to select a robust assembly design and to reduce unnecessary feedback processes on rapid selection of assembly processes.

Key words:
virtual assembly analysis; collaborative product development; computer-aided design; Internet; joining; assembly operation; welding; riveting; rapid prototyping; service-oriented architecture; *e*-tools; *e*-design; CAE; collaborative virtual prototyping and simulation; FEA; assembly design formalism; assembly analysis model; Pegasus service manager; *e*-design brokers; service providers

6.1. History and Overview

Generating over $1 trillion in annual revenue, the mechanical products industry is one of the leading industrial sectors in the United States economy. Throughout the sector, assembly operations account for a significant percentage of manufacturing activities. The U.S. Bureau of Labor Statistics indicates that those involved with assembly and welding processes exceed 2 million workers, which is more than 10 percent of the manufacturing workforce[1]. These numbers indicate that improving assembly operations will have an impact on manufacturing. While assembly processes in manufacturing industries are becoming mechanized and automated, the physical effects of assembly operations, particularly of welding, are still a major problem related to quality and productivity. The American Welding Society, in conjunction with the Department of Energy, has put together a vision that will carry the welding industry through 2020. They selected *assembly operation modeling*, *virtual simulation and testing*, and *proper joint determination* as key technology needs of industry.

Mechanical products are very rarely monolithic. Joints on a mechanical assembly are inevitable because of the limitations on component geometric configuration and material properties along with the requirements of inspection, accessibility, repair, and portability[2]. Very often joints are weak