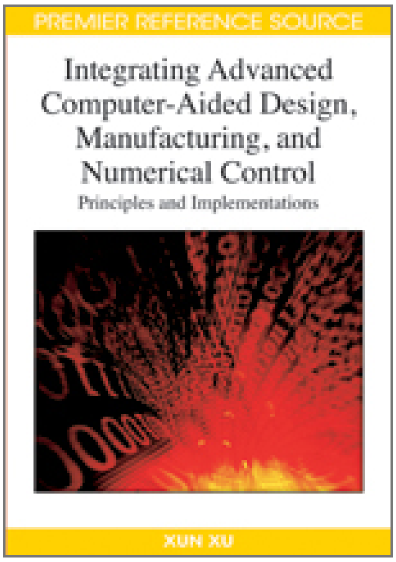

Integration Based on STEP Standards

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Abstract

The integration model (Model B) as discussed in the previous chapter makes use of exchangeable neutral data formats such as IGES (1980). Neutral data formats provide a middle tier to connect CAD and CAM systems. Thus, Model B can create a collaborative manufacturing environment and make the design data exchange possible for large projects at the international level. Yet, some problems still remain. IGES was designed to exchange geometrical information only, so additional design or manufacturing information (such as feature information) within a proprietary model is ignored. During data exchange, some information may become astray during data transfer; geometry stitching or model repair is often needed. Plus, IGES is not an international standard. As previously discussed, there are also problems common to both Models A and B (Figure 10.1). Different data formats (e.g. IGES and ISO 6983-1, 1982) are used in the designto- manufacturing chain. Data loss occurs in the transaction from design to manufacturing because only low-level, step-by-step sequential machining commands are passed onto the CNC controllers, leaving the complete product model behind. Of particular significance has been the endeavour made by the International Organization for Standardization to introduce the STEP Standard (i.e. ISO 10303-1 [1994]). Major aerospace and automotive companies have proven the value of STEP through production implementations resulting in savings of US $150 million per year (Gallaher, Oâ€™Connor & Phelps, 2002, PDES, Inc. 2006). Moreover, STEP has recently been extended to cater to manufacturing data modelling and execution with an aim to fill the information gap between CAD/CAPP/CAM and CNC. The standard is informally known as STEP-compliant Numerical Control, or otherwise STEP-NC for short. It was given an ISO name of â€œISO 14649: Data model for Computerized Numerical Controllers (ISO 14649-1, 2003)â€ , which defines the STEP-NC Application Reference Model. With STEP being extended to model manufacturing information, a new paradigm of integrated CAD/CAPP/CAM/CNC is emerging. This is illustrated in Figure 11.1. The key to this paradigm is that no data conversion is required and the data throughout the design and manufacturing chain are preserved. This chapter focuses on the use of STEP standards to support data exchange between CAD systems as well as facilitate data flow between CAD, CAPP, CAM, and CNC systems. Also discussed are the specific integration issues between CAD and CAPP, CAPP and CAM, and CAM and CNC using STEP standards. STEP-NC data model is a relatively new member in the STEP family, but it completes the entire suite of STEP standards from design to NC machining. Both Physical File Implementation Method (ISO 10303-21, 1994) and

XML Implementation Method (ISO/TS 10303-18, 2004) are presented as the two popular ways of implementing STEP and STEP-NC.

Chapter Preview

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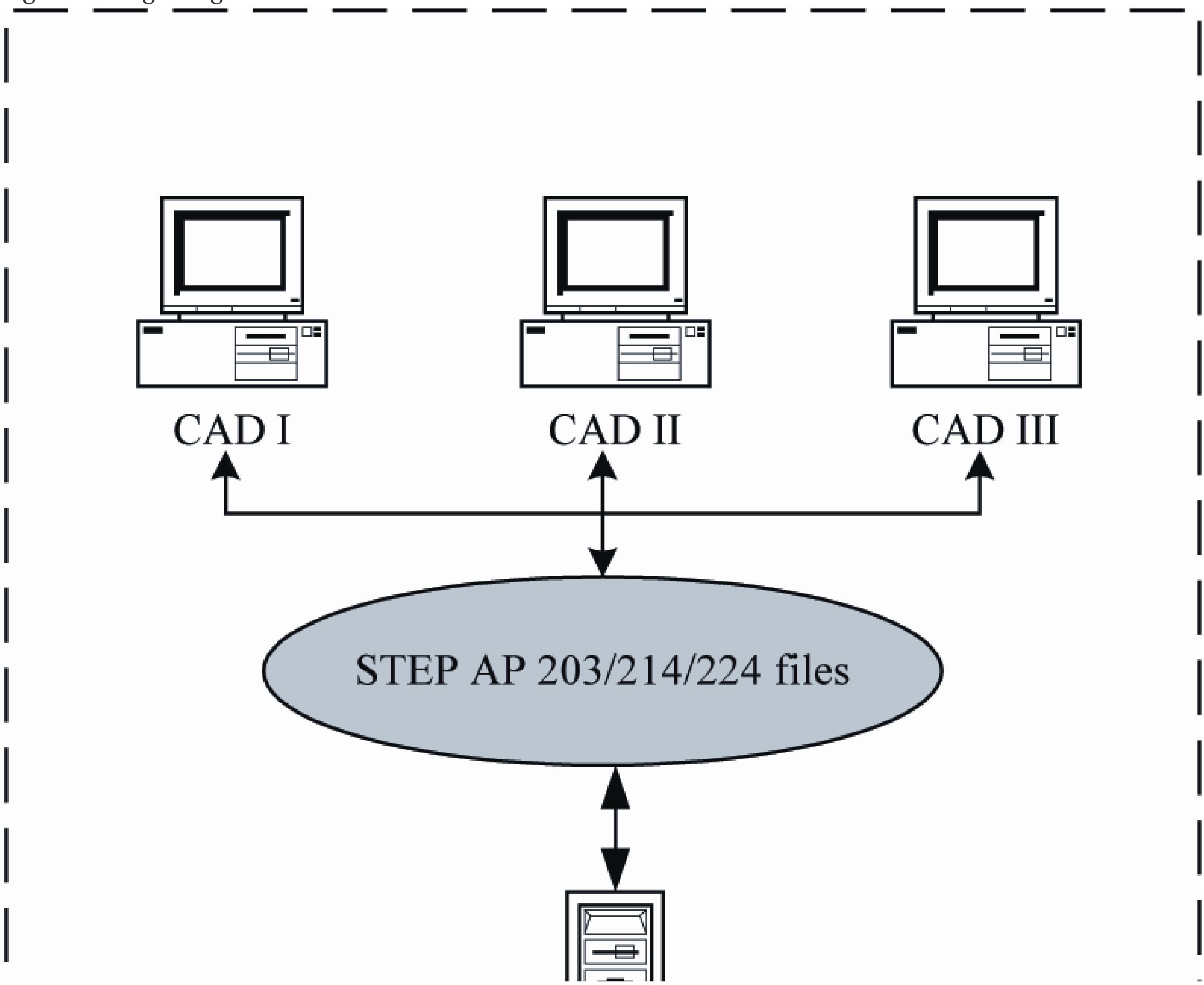
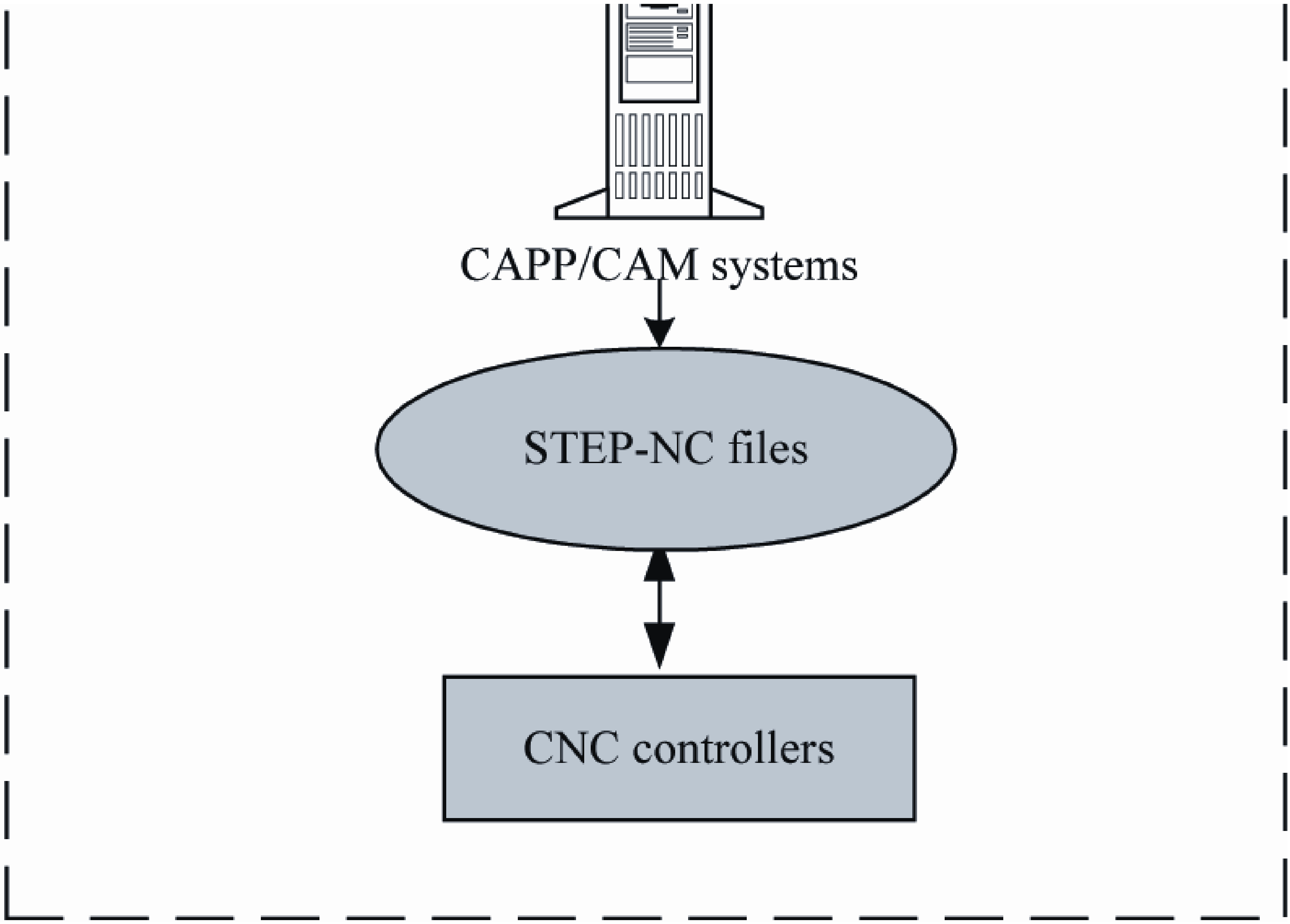
Data Exchange Using Step And Step-Nc

STEP has been briefly introduced in Chapter II. This section discusses the standard from the perspective of being a useful tool to support data exchange and integration. The keys to the STEP standard are, a. its generic nature, b. computer-interpretable format, and c. consistent data implementations across multiple applications and systems. They permit different implementation methods to be used for storing, accessing, transferring and archiving product data. The specification of a representation of product information is provided by a set of integrated resources. Each integrated resource comprises a set of product data descriptions, written in EXPRESS (ISO 10303-11, 1994) known as resource constructs. One set may be dependent on other sets for its definition. Similar information for different applications is represented by a single resource construct. The integrated resources are divided into two groups: generic resources and application resources. The generic resources are independent of applications and can reference each other. The application resources can reference the generic resources and can add other resource constructs for use by a group of similar applications. Application resources do not reference other application resources. (Figure 1)

Figure 1. Integrating CAD/CAPP/CAM/CNC





The integrated resources define a generic information model for product information. They are not sufficient to support the information requirements of an application without the addition of application specific constraints, relationships and attributes. STEP defines Application Protocols in which the integrated resources are interpreted to meet the product information requirements of specific applications, in other words Application Reference Model. The interpretation is achieved by selecting appropriate resource constructs, refining their meaning, and specifying any appropriate constraints, relationships and attributes. This interpretation results in an Application Interpreted Model. It is these AIMs that STEP brings data of differing applications under the same roof.

Data Exchange between CAD Systems

The STEP standard was initially designed to offer a neutral data exchange method in replacement of IGES. The two APs that have been established to mainly support design data exchanging and sharing are the AP for configuration controlled 3D designs of mechanical parts and assemblies (AP 203) (ISO 10303-203, 1994), and the AP for the core data for automotive mechanical design processes (AP 214) (ISO 10303-214, 1994). Currently, most of the commercial CAD systems can output STEP AP-203 and/or STEP AP-214 files via STEP translators. According to the report from Research Triangle Institute (1999), when STEP is used as a neutral format to exchange wireframe and surface data between commonly used commercial CAD systems, it fares better than IGES. This indicates that STEP is ready to replace IGES. However, the STEP standard is much more than a neutral data format that translates geometrical data between CAD systems. The ultimate goal of STEP is to provide a complete computer-interpretable product data format, so that users can integrate business and technical data to support the whole product life cycle: design, analysis, manufacturing, sales and customer services.

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