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Implementation of the direct integration from CAM to CAE for the PCB simulation

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ABSTRACT

Currently, an engineering analysis before manufacturing is an essential process in nearly every industry. To obtain more accurate results from an engineering analysis, the input data for the CAE system which performs the analysis should be well translated from the original data, such as CAD data or CAM data. However, in a company producing printed circuit boards (PCBs), it takes too much time to obtain CAE data from the original CAM data because a CAD system is typically located between the two systems. Most of the time is wasted when attempting to translate the shape information and when modifying the errors that arise during the manual work involved in the process. In this study, a new methodology for the direct and automatic translation from a CAM system to a CAE system is suggested. This methodology is based on macro-parametric methodology that is developed for exchanges of CAD data.

1. Introduction

At present, industry modifications of product designs based on the results of engineering analyses have become an essential step in the production design decision process before manufacturing. To prevent or to minimize problems with the product, the design is improved before manufacturing based on an engineering analysis. Printed circuit boards (PCBs) are among the products most sensitive to design changes because they are very thin and consist of composite layers. However, there are different shapes and materials depending on the PCB type [1], and it takes much time to perform a similar, but slightly different analysis for every case.

The problem is that most PCB designs start with CAM data. Most customers, such as electronics companies such as Samsung and Apple, do not simply send design data owing to security concerns over their intellectual property. As CAM data contains only the type and moving directions of the tools, the process of reproducing the engineering analysis data, which contains information related to the geometry, materials, and boundary conditions, is complex.

As shown in Fig. 1, the traditional four-step translation process from the CAM system to the CAE system is essential to create data for an engineering analysis from CAM data. For this reason, it takes about 14 days to obtain the final CAE data from CAM data. Unfortunately, 14 days does not satisfy what is known as the "time to market," which is one of the most important objectives in modern manufacturing [2]. The errors that occur during any manual work constitute another reason for this lost time. Because all data are translated and simplified manually, many errors are generated during these processes. Reliability also decreases.

The time for creating the engineering analysis data should be reduced, as it is difficult to reduce the time for solving the problem and the post process and final design decision process. In this research, by applying a macro-parametric methodology, as suggested for the exchange of general CAD data, into the as-is process, a simplified translation process that directly obtains analysis data from CAM data automatically is realized. For verification of this, the new process is applied to a PCB manufacturing company.

2. Related research – macro-parametrics methodology

Macro-parametrics methodology is a methodology for the exchange of product model data between CAD systems. Although there are many commercial CAD systems that facilitate exchanges of CAD model data, most of these systems are based on B-rep (boundary representation). As a result, the design intent can be lost during the exchange process, and it is impossible to change the parameters after the exchange. Some programs use certain methods to change the parameters after an exchange, but no programs can compensate for the loss of design history.

To improve this situation, the macro-parametrics methodology is proposed. This methodology uses a macro file from a CAD system

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Fig. 1. Flow diagram of the AS–IS process.

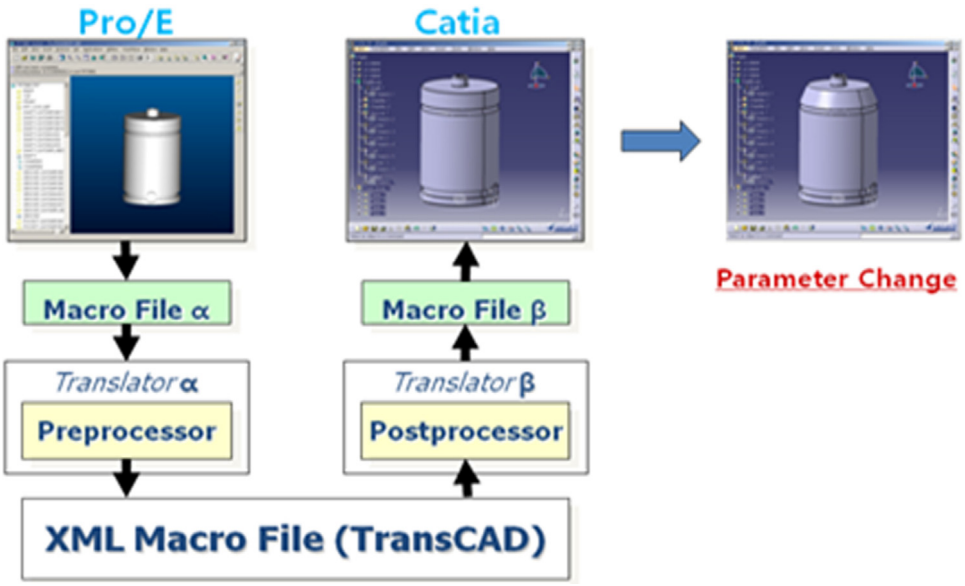

Fig. 2. Exchange of CAD data using the macro-parametrics method [6].

for the exchange of model data. A macro file is a type of text file that includes a recording of user operations on the CAD system during the creation of a model. Every CAD system has its own macro file format. Because the creation history and modification history are both included in the macro file, the original design intent is still preserved after a data exchange [3–5].

Fig. 2 shows how the macro-parametrics method can be used to exchange data between PRO/E and CATIA, two well-known commercial CAD systems. A macro file recorded in Pro/E is translated into a neutral XML macro file. This process is called "pre-processing". Next, this XML neutral macro file is translated into a CATIA macro file in a process called post-processing. As shown in Fig. 2, the same model is created in CATIA and the design parameters can be changed after the translation [6].

Like a macro file in a CAD system, a CAM file has the format of a text file (Fig. 3). A Gerber file is a typical CAM file format used in the manufacturing process of a PCB. This file expresses machine relationships such as traces, vias, and lands. Drilling or milling information is also included in this file. The Gerber file, made by specialized software, is sent to a company equipped with the proper types of machines. Presently, the format RS-274X is the most popular format for a Gerber file.

CAE systems such as ABAQUS and ANSYS have their own macro files. Hence, the macro-parametrics methodology is applied to the translation of design data from the CAM system to the CAE system. The CAM file can be regarded as a type of macro file because it includes the machining process [7]. The CAM file can be converted into internal data through pre-processing, after which this data can

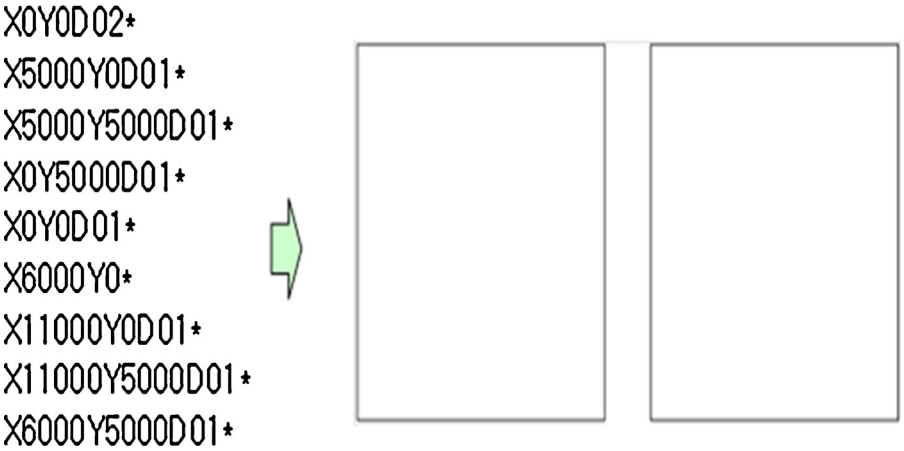

Fig. 3. CAM file and its shape.