

Metrics for Evaluating Design of Reconfigurable Machine Tools

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Abstract. This paper shows the development of metrics for evaluate the design of reconfigurable machine tools to process bamboo, which allows the numerical comparison of reconfigurability parameters in the design process, based on a concurrent design methodology to Reconfigurable Machine Tool development. In response, metrics for evaluate the development of this type of machine tools is outlined.

Keywords: Metric, Reconfigurability, Design, Machine Tools.

1 Introduction

The manufacturing tendencies reflect the changes on the customer demands over the years. Nowadays the market is constantly requiring more customized products, moving from mass production, through mass customization in less time with lower production costs. These conditions demand the development and application of approaching which allows to convert the production to new models capable of integrating new technologies and of increasing the variety of products.

The reconfigurable manufacturing system, will allow flexibility not only in producing a variety of parts, but also in changing the system itself. Such a system will be created using basic process modules –hardware and software– that will be rearranged quickly and reliably. The art and science of RMT (Reconfigurable Machine Tools) development are still at their developmental stage.

A goal of the work presented in this paper is to provide metrics for evaluate the design of reconfigurable machine tools to process bamboo, which allows the numerical comparison of reconfigurability parameters in the design process, based on a concurrent design methodology to reconfigurable machine tool development. On section 2 a literature review of research in studies about the metrics in engineering design is presented. A reference methodology for metrics development is described in

Section 3. Section 4 presents the metrics for evaluating design of reconfigurable machine tools. Finally, Section 5 deal with the metrics applied on reconfigurable bamboo processing machine design.

2 Related Previous Studies

There are several studies related to developing metrics to evaluate different aspects in design process, these metrics are a great aid to designer's decision making in engineering. Table 1 summarizes the major studies about the metrics in engineering design.

Table 1. Summary of studies about the metrics in engineering design

Fields of research	Authors
— Design for variety: developing standardized and modularized product platform architectures (based on QFD analysis)	Martin, M. V.; Ishii, K. [6]
— Methodology for understanding the costs of product proliferation	Martin, M. V.; Ishii, K. [4]
— Assessing value in plat formed product family design	González, J. P.; Otto, K. N.; Baker, J. D. [2]
— A metric for evaluating design commonality in product families	Kota, S.; Sethuraman, K.; Miller, R. [3]
— Design for variety: development of complexity index and design charts	Martin, M. V.; Ishii, K. [5]
— Setting target product requirements: decision analytic approach	Takai, S.; Ishii, K. [9]
— Platform-driven development of product families: linking theory with practice	Vuuren, W. V.; Halman, J. I. M. [10]
— Optimal selection of module instances for modular products in reconfigurable manufacturing systems	Yigit, A. S.; Allahverdi, A. [11]

Research related to the developing of indexes and charts which allow studying the different factors involving machine tools reconfigurability are directed in focusing in the search of coefficient which can connect several aspects for developing products family and variety.

Concerning machine's reconfigurability there are few studies reflecting the analysis of features that permit a comparison between many concepts in a machine tools.

3 Reference Methodology for Metrics Development

The general characteristics of a methodology based on modularity are proposed by Pérez *et al.* [7]. The proposed methodology for the modular development of RMT's establishes four domains which go from the requirements of the machine tool builder to the definition of the reconfigurable modularity. Each layer established by the