

STEP-NC compliant intelligent process planning module: Architecture and Knowledge base

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Abstract

STEP-NC (ISO 14649) is a new feature-based machine tool control language between CAM and CNC. In contrast with conventional G&M code (ISO 6983), it could provide richer and more machining information for CNC controller at shop floor. Therefore, it's feasible to develop an embedded micro process planning module in CNC controller. Meanwhile, some other information models such as manufacturing resources are essential for completing the intelligent process planning. The main thrust of this paper is focused on two fields: i) Proposition of a framework for STEP-NC compliant controller, ii) Development of knowledge base with OWL for the process planning in CNC controller. A novel STEP-NC compliant controller named OntoStep CNC is presented, which could accept ISO 14649 machining models and then generate optimized tool path based on knowledge base and rules at the shop floor level.

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1. Introduction

Over the years, people have been put forward some ideas and concept such as CIMS (Computer integrated manufacturing system) and FMS (Flexible manufacturing system) to make the manufacturing more rapid, efficient and flexible. While the CNC controller, which is located at the lowest level and

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recognized as the elementary component in the manufacturing system still use the G&M code as it's control language. The G&M code only includes motion and switch instructions. The CNC controller is totally a passive executor with the G&M code as input, and becomes a solitary island in the whole manufacturing system. This bottleneck is expected to be removed with the advent of a new data model named STEP-NC (ISO 14649), which is developed under ISO TC184/SC1. STEP-NC is feature-based and well-structured product data model, which act as a highway between CAM and CNC, less information is lost [1].

Information models play an import role within the manufacturing system. Fig. 1 shows us that different information models are integrated in different level of manufacturing system. Requirement analysis for intelligent process planning at shop floor level: (1) Modern smart machining need to make complex decisions, such as how to select the right machine tools and cutting tools for certain part or process to obtain better surface roughness and precision, how to arrange the working-step to improve efficiency for machining, how to restart machining after a breakdown happened but don't need to reserve to cam systems. (2) Complex decisions for smart machining require lots of information and applied knowledge. So some domain information models such as part information and shop floor resource information are necessary for intelligent process planning. (3) web-based knowledge communication and sharing.

The ontology, which is a recent information technology, is a collection of key concepts and their inter-relationships collectively providing an abstract view of an application domain that could present an understandable and interoperable format for both humans and machines [2]. This study develops an ontology-based knowledge-base for manufacturing resource and also proposes a novel mechanism that could convert ISO 14649 into ontology-based knowledge. The knowledge base could not only be regarded as a necessary supplement for expert system in process planning but also reused and shared among different software applications.

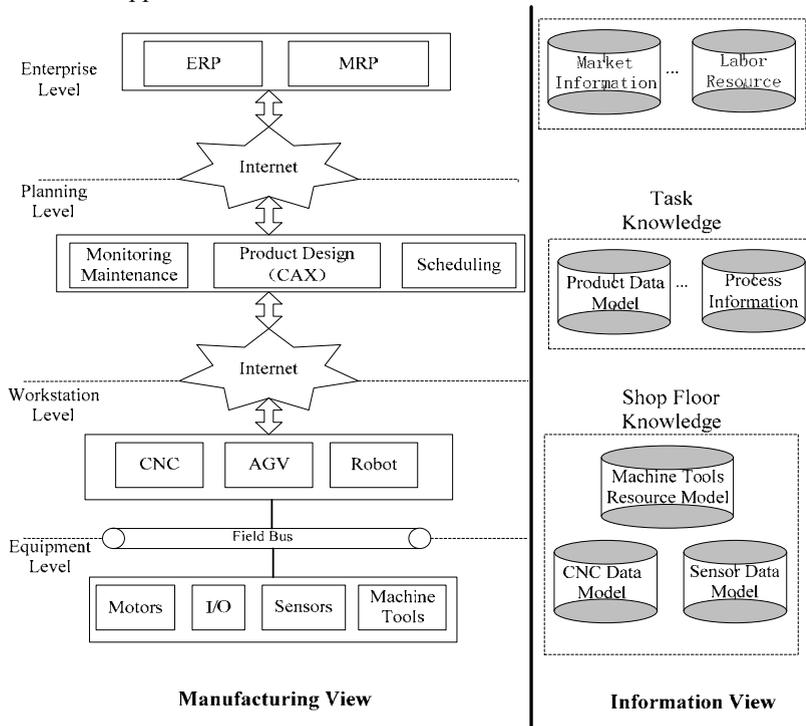


Fig. 1. An essential framework for Information integrated Manufacturing system

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