

A DESIGN-BY-FEATURE APPROACH TO STEP-COMPLIANT NC PROGRAMMING

RILIANG LIU, XIANZHI ZHANG, CHENGRUI ZHANG AND LU WANG

School of Mechanical Engineering
Shandong University
73 Jingshi Road, Jinan, Shandong Province 250061, P. R. China
liuriliang@sdu.edu.cn

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ABSTRACT. *ISO 14649 (STEP-NC) presents a high-level and STEP-compliant language for writing a part program that enables a comprehensive description of the machined part together with technological information to be passed in a well-organized structure down to the CNC machine. In order to automate and streamline the generation process of such rich-information programs, this paper proposes to use the STEP-NC manufacturing features right at the modelling stage, and presents an integrated framework for part modelling, process planning and part program generation through direct use of the manufacturing features and the adoption of the STEP-NC data model. To examine the feasibility a STEP-NC programming system (SPS) is designed with respect to the prismatic parts with 2.5D manufacturing features. Major issues relating to feature validation and process planning are addressed in particular, and a prototype is implemented to demonstrate the feasibility and potential advantages of the approach.*

Keywords: NC programming, NC manufacture, STEP-NC, Manufacturing feature

1. Introduction. With the advent of computer numerical control (CNC) in the 1970s and the rapid development of CAD/CAM (Computer Aided Design/Manufacturing) technologies over the last decades, significant progress has been made in automated manufacturing of mechanical parts [1]. However, the programming language used in industry to code the machine has remained basically the same with the original standards known as G&M codes (ISO 6983), which is based on description of tool motion commands and on/off instructions.

Nowadays an international standard, entitled ISO 14649 and informally known as STEP-NC [2], is being developed to provide a revolutionary interface for CAM/CNC integration using a kind of programming language in compliance with the STEP standard (ISO 10303). Unlike the G&M codes, which program the movements of the machine axes and switches, STEP-NC is a comprehensive data model that associates the machining objectives (CAD design data) with solutions (CAM process data required) in an object-oriented way. As a consequence, a STEP-NC part program seems more like a detailed process plan than a procedure of the machining process. In such a part program, the manufacturing data for a component is organized as a project, which aims to inform the CNC machine tool, of the geometry to be produced, the manufacturing features to be manufactured, the workingsteps (specific operations) needed for each feature, the technological requirements, and the execution sequence etc.

The high-level and object-oriented language provides a way for portable programs that can be used without changes across a number of machines. More importantly, it is building up a bi-directional information highway between the CAD/CAM and CNC systems [3] and