Chapter 7
Integrated Kinematic Machining Error Compensation for Impeller Rough Tool Paths Programming in a Step-Nc Format Using Neural Network Approach Prediction

Hacene Ameddah
https://orcid.org/0000-0003-2572-7372
Laboratory of Innovation in Construction, Eco-Design, and Seismic Engineering (LICEGS), University of Batna 2, Batna, Algeria

ABSTRACT

The most important components used in aerospace, ships, and automobiles are designed with free form surfaces. An impeller is one of the most important components that are difficult to machine because of its twisted blades. This research book is based on the premise that a STEP-NC program can document "generic" manufacturing information for an impeller. This way, a STEP-NC program can be made machine-independent and has an advantage over the conventional G-code-based NC program that is always generated for a specific CNC machine. Rough machining is recognized as the most crucial procedure influencing machining efficiency and is critical for the finishing process. The research work reported in this chapter focuses on introduces a fully STEP-compliant CNC by putting forward an interpolation algorithm for non uniform rational basic spline (NURBS) curve system for rough milling tool paths with an aim to solve the problems of kinematic errors solutions in five axis machine by neural network implementation.

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INTRODUCTION

In the vision of the contemporary product design and manufacturing environment requires a bidirectional and seamless data flow throughout all stages of data transactions. The establishment of STEP (STandard for Exchange of Product data) offers manufacturers a new method to exchange product data in the entire product life cycle. As an extension to STEP, STEP-NC provides the potential to finally close the gap between design and manufacturing in the drive for a complete, integrated product development environment. The STEP-NC data model is a long overdue improvement in the domain of computer numerical controls (CNC) where G-codes have been in use for more than half a century. STEP-NC brings richer information to CNCs presenting an opportunity for the development of more intelligent, interoperable and informative machining. The manufacturing of a single twisted ruled surface needs at least four freedoms and a freedom of rotation workpiece should be added when machining an integrated impeller. For such complex shapes, five-axis machining is generally adopted (Young, H T., Chuang, L C., 2003). Furthermore, the two additional degrees of freedom have many advantages such as high productivity, machining quality, and more flexible tool-path planning methods (Pinghan, Wu., Yuwei, Li.2008). Therefore, it is wise and necessary to adopt a five-axis machine tool to manufacture impellers with twist blades. In order to solve complex free-form surface CNC machining, major manufacturers of CNC systems, such as Heidenhain, Siemens, Fanuc, have utilized basis spline (B-spline), and Non uniform rational basis spline (NURBS) interpolation methods for free-form surface machining and achieved good machining results (Cheng, and all., 2002) (Koninckx, B., Vanbrussel, H., 2002). In this book, we propose a procedure to resolve inverse kinematics of Five-axis machine (TTTRR). Three linear axes (X, Y, and Z) and two rotary axes (A, C) comprise this machining, the table moves linearly in the X and Y directions while the head moves linearly in Z direction. The table also tilts about the X-axis and rotates about the Z-axis (angles A and C, respectively), using a structured multilayer perceptron (MLP), that can be trained quickly. The result of each network is assessed using inverse kinematics equations to extract information about inverse kinematics error. Otherwise stated, the tool orientation and position obtained for each link is used to compute the Cartesian coordinate for the end effector. The most important components used in aerospace, ships, and automobiles are designed with free form surfaces. An impeller is one of the most important components that are difficult to machine because of its twisted blades. This research book is based on the premise that a STEP-NC program can document "generic" manufacturing information for an impeller. This way, a STEP-NC program can be made machine-independent and has an advantage over the conventional G-code based NC program that is always generated for a specific CNC machine. Rough machining is recognized as

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