

# Preface

CNC controllers, working as a brain for manufacturing automation, are high value-added products accounting for over 30% of the price of machine tools. CNC technology is generally considered as a measure of the level of manufacturing technology of a nation, and is currently led by major advanced countries such as USA, Japan, and Germany. CNC technology, which cannot be developed with one single technology but needs to integrate computer technology, hardware technology, machining technology, and so on, is often referred to as “The Flower of Industrial Technology”, and requires a strategic long-term support, mostly on a governmental level.

Despite its significant role, textbooks on CNC controllers are quite rare worldwide, with a few published in the 1970s and some later. However, the earlier ones mostly deal with conventional technologies, while the later ones deal with fragmental contents, mostly focusing on part programming and machine operation. This book is written by several authors in collaboration who have long experience in CNC development, education, and research, and is designed as a highly focused textbook to provide knowledge on the principles and development technologies of CNC controllers. Therefore, this book can be used as a main textbook for courses related to CNC in such departments as mechanical engineering, precision engineering and control engineering, and as a guide for those working on CNC development in industry. If highly descriptive portions are taken out, it can also be used as lecture material in technical colleges.

The framework of industrial CNC controllers has been established by integrating the structure and element technologies of CNC controllers under research and development by the authors in their respective field of industry and academia over the years. Furthermore, this book intends to encourage the spirit of development by introducing actual realization cases.

This book is composed of two parts with a total of 11 chapters: Part I is composed of Chapters 1–6 on the principle and design of CNC, and Part II is composed of an open-architectural soft CNC system. Specifically, Chapter 1 provides general concepts and mechanisms of numerically controlled machines, while Chapters 2 through 5 cover the element technologies of NCK in charge of controlling the transfer axis, including interpreter, interpolator, control of acceleration and deceleration, and po-

sition control system. In Chapter 6, NCK development cases are described together with source code. Therefore, those who are interested in motion controllers can develop independent control devices by referring to the contents of Chapters 2 through 6.

Part II describes the open-architectural soft CNC system, including the principles of major modules of numerically controlled machines, except the NCK (dealt with in Part I), and the system design process for the composition of the overall system from the perspective of open-architectural soft CNC systems. Specifically, Chapter 7 explains the PLC, controlling most mechanical motions except the transfer axis, while Chapter 8 presents the principles of the Man-Machine Interface (MMI) and the major modules for the development of conversational programming methods. Real-time operation concepts and methods necessary for designing real-time controllers are described in Chapter 9, Chapter 10 describes the architecture design of CNC systems based on personal computers. This is discussed from the perspective of soft CNC, including several approaches to the architecture of open-style CNC system with free external interfaces, and the design process of those approaches. The concept and primary elements of STEP-NC are introduced in Chapter 11, which has recently come under the spotlight as a method of realizing intelligent CNC machines. Therefore, those who are interested in designing and realizing open-style soft CNC devices can refer to the topics covered in Chapters 7 through 11 to materialize intelligent open-style NC devices.

As authors of this book, we recommend that instructors have their students actually code the NCK technologies (Chapters 2 through 5), which are the core elements, and finish a computer simulation system, one similar to the development case covered in Chapter 6, and verify the performance. One step further, if the interface board (encoder signal and PLC signal processing) and the XY-table can actually be connected by the students, the effect of learning can be doubled.

Those students who want to learn the general technologies related with CNC systems can achieve their goals by studying the PLC, conversational programming system, particularly actual cases of system programming methods to realize soft CNC, as covered in Part 2, Chapters 7 through 11.

To complete this book it took over three years to collect and organize all sorts of material accumulated over a period of many years, including technical papers and patent data materials. However, we feel there are many shortcomings. Some of the excuses we can offer could include the fact that CNC technology has been developed by industry itself and that each element technology derives from a completely different domain of knowledge. Therefore, for integrating them under the umbrella of CNC for academic purposes, many problems are posed such as un- or mis-defined technical terminologies and lack of systematic knowledge bases. However, despite this, the authors decided to publish this book in the hope that it will contribute to the advancement of CNC technology both at home and abroad, in consideration of the sheer reality that no proper textbooks are available for education or training in CNC technology. With lots of input from the readers, we hope this book can improve its contents in the future.

This book was originally published in Korean and has now been translated into English. We would like to take this opportunity to express our appreciation to Ms. Eunsook Choi, who encouraged preparation of the English version of the original Korean text book, Mr. Suho Jung and students of the Center for ubiquitous manufacturing at POSTECH for help in the editing, and Springer who willingly accepted publication of it.

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