

实用数控技术丛书

数控技术英语

刘 瑛 徐宏海 罗学科 编



化学工业出版社

工业装备与信息工程出版中心

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序

机械制造业是国民经济的支柱产业。据统计,美国 68% 的社会财富来源于制造业,日本国民总产值的 49% 是由制造业提供的,我国的制造业在工业总产值中也占有 40% 的比例。可以说,没有发达的制造业,就不可能有国家的真正繁荣和富强。而机械制造业的发展规模和水平,则是反映国民经济实力和科学技术水平的重要标志之一。提高加工效率、降低生产成本、提高加工质量、快速更换产品,是机械制造业竞争和发展的基础,也是机械制造业技术水平的标志。

20 世纪 50 年代初第一台数控机床的出现,使制造技术的发展出现了日新月异的局面。特别是近 20 年来,随着计算机技术、信息技术和微电子技术等高新技术的发展,制造业也发生了革命性的变化。数控技术在现代企业的大量应用,使制造技术正朝着数字化的方向迈进,出现了以信息驱动的现代制造技术,其核心就是数控加工设备替代了传统的加工设备。与此同时,数控技术正在朝着高精度、高速度、高柔性、高可靠性以及复合化(工序复合化,功能复合化)的方向发展。这一领域的研究是在当前高新技术不断发展的背景下进行的,涉及许多相关领域、交叉学科。当前,在人才需求方面,除需要具有数控技术基本知识和能力的高素质人才,促进研究与开发工作的新突破外,还急需大批数控技术应用型人才,即数控编程、数控设备操作及其维修人员。而几乎大部分制造企业在这方面的人才严重不足,特别是北京、上海和南方较发达地区,对数控应用型人才更是求贤若渴,许多企业纷纷用高薪聘请。为了培养国内急需的数控应用人才,各高等院校、职业技术学院纷纷举办高职层次的数控类专业。然而,到目前为止还缺乏适应这类学生使用的、针对数控技术教育的系列教材和适应企业培养数控应用人才的系列参考书,《实用数控技术丛书》就是为此目的编写的。

《实用数控技术丛书》一套共 6 册,近 200 万字,内容涉及数控技术从理论到实际加工操作的各个环节。其中,《数控原理与数控机床》讲述数控技术的基本原理和数控机床的结构;《数控编程技术》详细地讲述各类数控机床和加工中心的编程原理和手工编程方法;《数控加工工艺学》则重点讲述在数控机床的应用中涉及的工艺问题,包括数控设备用刀具、夹具等工艺装备的选择和使用;《CAD/CAM 与数控自动编程技术》讲述目前大量使用的 CAD/CAM 技术和数控自动编程技术,并结合市场上常用的 MASTER CAM、CAXA 等专业软件,给出了大量的典型实例;《数控技术英语》是本专业的专业英语教材,在编写上考虑了数控专业的特点,并注意使用者的英语水平;《数控加工综合实训》是配合实践教学使用的教材,重点突出系统性、实用性和实践性的特点。

《实用数控技术丛书》既参考了国内外相关领域的书籍和资料,也融会了作者们长期以来的教学实践和研究心得,特别是北方工业大学机电中心 5 年来在国家级高职数控技术专业教学改革试点专业中的教学经验和教训。它的出版对推动机械制造企业采用新的数控技术、改造和提升传统产业将会产生积极的影响。

《实用数控技术丛书》立足于应用，面向大专院校、高职学校师生和工程技术人员。在内容组织和编排上从理论到实践、由浅入深、图文并茂、通俗易懂。丛书特别强调实践，书中的大量实例来自生产实际和教学实践。丛书不但为高职数控类专业提供了完备的系列教材，也为企业培训数控技术应用人才提供了参考书籍，对相关工程技术人员也是一套很有益的参考书。

工学博士、机械工程教授 罗学科

2003年3月于北京

前言

编者在海外生活期间,感触最深的是:来自印度、巴基斯坦等国家的学生,其英文程度普遍高于中国学生,尤其是阅读和写作水平。究其原因,主要归功于他们在中学、大学学习期间大量使用英语教材教学,于是学生在学习各种专业课的同时,不知不觉地提高了英语水平。而在我国,英语课似乎一直是独立于其他科目之外的特殊课程。编者认为,对于绝大多数中国人来说,英语其实仅仅是个工具,如果不和自己的工作和专业结合,几乎是没有意义的。

随手翻翻这本教材,您会发现,相对传统的英语教材而言,它更像一本数控专业教材——系统、全面、图文并茂地阐述了与数控机床相关的各类信息。之所以这样安排,主要是基于上面的认识。

本书在编写过程中力求体现下面几个特色。

1. 内容的先进性 引入和介绍了数控领域的最新技术和知识。
2. 图文并茂 对于有一定数控专业基础的读者而言,通过文中大量的图例即可猜测出各段文字大意。即通过专业知识帮助和促进英语水平的提高。
3. 课后练习的专业性 课后练习的内容着眼于巩固本单元所学的专业知识,形式多为问答题。这样安排的目的是为了让学生学会用英文表达自己的专业。与某些传统的英语教材不同,本书从不赞成学生把精力放在选择 A, B, C, D 的文字游戏中。
4. 栏目设计的新颖性和趣味性 除了教材中必有的课文、单词、注解和练习之外,本书还设计了 Occupation Link 和 Laugh and Memorize 栏目。Occupation Link 中多为与数控机床有关的各种安全操作规程、常见警告信息、招聘广告和求职信等,对学生将来在本行业中就业是非常有实际意义的。另外,专业英语的学习往往是枯燥无味的,为了提高学生的兴趣,在 Laugh and Memorize 栏目中,我们用非常滑稽可笑的联想方式帮助大家牢牢记住该领域中使用最频繁地一些单词,同时也教给大家一种有趣有效的记忆方法。授课老师还可以选择更多需要记忆的单词,让班上的同学发挥想像力和创造性,竞相提出自己的滑稽联想妙招,争取达到一经看到,过目不忘的效果。相信这种方法会让枯燥的学习变得妙趣横生。

本书可作为大专院校、高等职业技术学院数控技术类专业的专业外语教材,也可作为工程技术人员自学参考用书。

本书编者要特别感谢教育部和北京市教育委员会将北方工业大学计算机数控专业确定为国家和北京市首批教改试点专业,这为我们编写这本书提供了精神动力。同时还要感谢学校领导对我们的支持。

由于时间紧迫,书中难免有错误和不足之处,恳请读者发 E-mail 到 xk-luo@263.net 给予批评和指正。

编者

2003 年 3 月于北方工业大学

内 容 提 要

本书涵盖了数控技术的各个方面，包括数控原理、数控机床、数控加工、数控编程、数控生产车间等各个方面的数控技术英语知识。内容丰富，技术先进，许多技术内容都来源于国外原著，实用性强。

本书适用大专院校、高职学校师生作为专业教材，也可供数控工程技术人员自学参考。



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UNIT 1 INTRODUCTION TO COMPUTER NUMERICAL CONTROL MANUFACTURING

1.1 Introduction

At the conclusion of this unit you will be able to

1. Explain what computer numerical control (CNC) is and what basic components comprise CNC systems.
2. State the objectives, advantages, and special requirements concerning CNC use.

1.2 Numerical Control Definition, Its Concepts and Advantages

Numerical control has been used in industry for over 40 years. Simply put, numerical control is a method of automatically operating a manufacturing machine based on a code of letters, numbers, and special characters. A complete set of coded instructions for executing an operation is called a program.^① The program is translated into corresponding electrical signals for input to motors which run the machine. Numerical control machines can be programmed manually. If a computer is used to create a program, the process is known as computer-aided programming. The approach taken in this text will be in the form of manual programming.

Traditionally, numerical control systems have been composed of the following components.

Tape punch: converts written instructions into a corresponding hole pattern. The hole pattern is punched into tape which passes through this device. Much older units used a typewriter device called a Flexowriter. Newer devices include a microcomputer coupled with a tape punch unit.

Tape reader: reads the hole pattern on the tape and converts the pattern to a corresponding electrical signal code.

Controller: receives the electrical signal code from the tape reader and subsequently causes the NC machine to respond.

NC machine: responds to programmer signals from the controller. Accordingly, the machine executes the required motions to manufacture a part (spindle rotation on/off, table and or spindle movement along programmed axis directions, etc.) .

See Figure 1-1.

NC systems offer some of the following advantages over manual methods of production.

1. Better control of tool motions under optimum cutting conditions.
2. Improved part quality and repeatability.

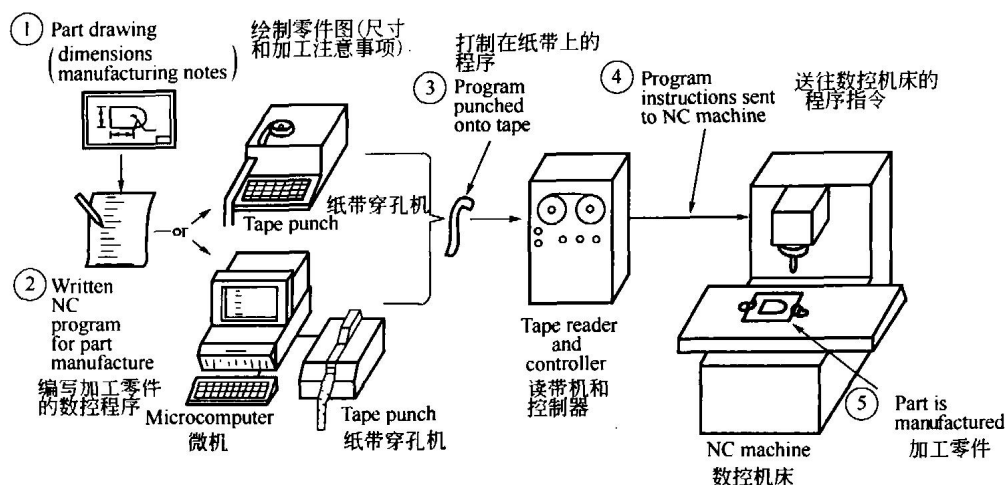


Figure 1-1 Components of traditional NC systems

传统 NC 系统的组成

3. Reduced tooling costs, tool wear, and job setup time. ②
4. Reduced time to manufacture parts.
5. Reduced scrap.
6. Better production planning and placement of machining operations in the hands of engineering. ③

New words

approach [ə'prəʊtʃ] *n.* 方法

convert [kən'veɪt] *vt.* 转换 改变

corresponding [kə'resɪ'pɒndɪŋ] *adj.* 相应的, 一致的, 符合的

punch [pʌntʃ] *vt.* 打洞, 打孔, 猛击

flexowriter ['fleksəraɪtə] *n.* 电传打字机

couple ['kʌpl] *vt.* 联合, 连接, 结合; *vi.* 结合, 结婚; *n.* (一) 对, (一) 双, 夫妇

subsequently ['sʌbsɪkwəntli] *adv.* 以后, 后来

accordingly [ə'kɔ:dnɪli] *adv.* 因此, 于是,

相应地, 如前所说, 适当地

spindle ['spɪndl] *n.* 主轴, 轴

table ['teɪbl] *n.* 工作台

optimum ['ɒptɪmə] *adj.* 最佳的, 最有利的, 最适宜的

repeatability [rɪ'pi:tə'bɪlɪti] *n.* 可重复性

scrap [skræp] *n.* 废料, 碎片

engineering [ˌendʒɪ'niəriŋ] *n.* 工程学, 工程

Notes

① A complete set of coded instructions for executing an operation is called a program.

code: 大家都知道 code 是代码的意思, 可能会忽略它的动词含义——译为代码。这里是用它的过去分词形式修饰 instruction, 因此本句的意思是: 所谓程序就是用于执行某一操作的一整套代码表示的指令。

② Reduced tooling costs, tool wear, and job setup time.

降低加工成本, 减少刀具磨损和作业准备时间。

- ③ Better production planning and placement of machining operations in the hands of engineering.

in the hand of 在……掌握中，被……控制

有利于做出更好的制造规划，并使加工操作安排更易于控制。

1.3 Definition of Computer Numerical Control and Its Components

A computer numerical control (CNC) machine is an NC machine with the added feature of an on-board computer. The on-board computer is often referred to as the machine control unit or MCU. Control units for NC machines are usually hard wired. This means that a machine functions are controlled by the physical electronic elements that are built into the controller. ^① The on-board computer, on the other hand, is “soft” wired. Thus, the machine functions are encoded into the computer at the time of manufacture. They will not be erased when the CNC machine is turned off. Computer memory that holds such information is known as ROM or read-only memory. The MCU usually has an alphanumeric keyboard for direct or manual data input (MDI) of part programs. Such programs are stored in RAM or the random-access memory portion of the computer. They can be played back, edited, and processed by the control. All programs residing in RAM, however, are lost when the CNC machine is turned off. These programs can be saved on auxiliary storage devices such as punched tape, magnetic tape, or magnetic disk. Newer MCU units have graphics screens that can display not only the CNC program but the cutter paths generated and any errors in the program.

The components found in many CNC systems are shown in Figure 1-2.

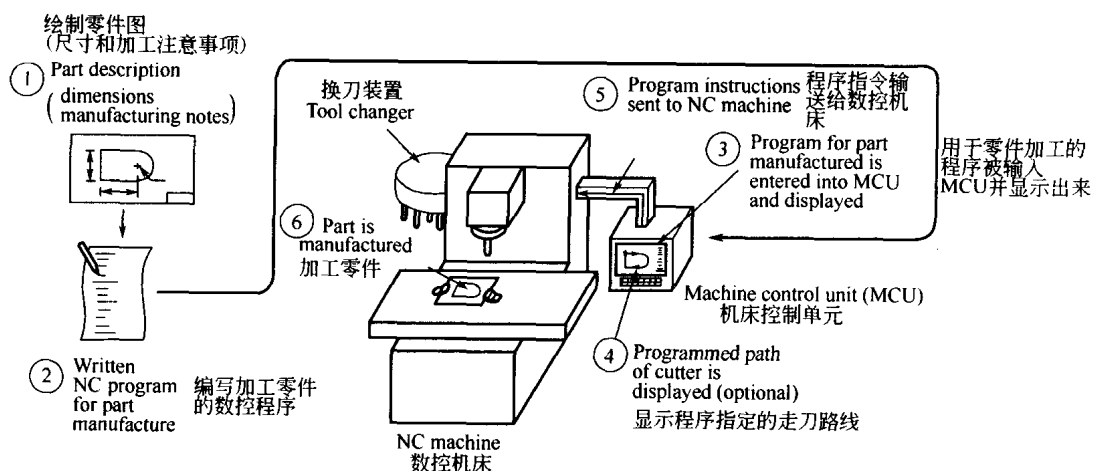


Figure 1-2 Components of modern CNC system
现代 NC 系统的组成

Machine control unit: generates, stores and processes CNC programs. The machine control unit also contains the machine motion controller in the form of an executive software program. ^②

NC machine: responds to programmed signals from the machine control unit and manu-

factures the part. ③

New words

feature ['fi:tʃə] *n.* 特色, 功能

on-board 在船(飞机, 车)上, 文中指内嵌在机床上

refer to 指, 谈到, 参照

wire ['waɪə] *vt.* 用金属线捆扎、联结或加固; *n.* 金属丝, 电线, 电报, 电信, 铁丝网

erase ['i:reiz] *vt.* 抹去; 擦去

ROM (read-only memory) 只读存储器

RAM (random-access memory) 随机存取存储器

alphanumeric [ˌælfənju:'merik] *adj.* 字母与数字构成的

portion ['pɔ:ʃən] *n.* 一部分, 一份

reside [ri'zaid] *vi.* 居住; 存在; 储存

auxiliary [ɔ:g'ziljəri] *adj.* 辅助的, 辅助的, 协助的, 附加的

magnetic [mæg'netik] *adj.* 磁性的, 磁学的

graphics ['græfiks] *n.* 制图法; 图解算法

Notes

① Control units for NC machines are usually hard wired. This means that a machine functions are controlled by the physical electronic elements that are built into the controller. NC 机床的控制单元通常由硬件构成, 也就是说机床的功能是由控制器内置的物理电子元件控制的。

注: 该句的难点在于 wire 这个词, wire 做名词是电线、金属丝的意思, 这个大家都很熟悉, 做动词则表示用金属线捆扎、联结或加固。在本句中直译的话应该是: NC 机床的控制单元通常是硬联结的。

② The machine control unit also contains the machine motion controller in the form of an executive software program.

机床控制单元还包括机床运动控制器, 该控制器是一个可执行的软件程序。

注: in the form of 以……的形式。

③ NC machine: responds to programmed signals from the machine control unit and manufactures the part.

NC 机床: 响应来自机床控制单元的程序信号并加工零件。

1.4 Advantages of CNC Compared to NC

Computer numerical control opens up new possibilities and advantages not offered by older NC machines. ① Some of these are

1. Reduction in the hardware necessary to add a machine function. New functions can be programmed into the MCU as software.
2. The CNC program can be written, stored, and executed directly at the CNC machine.
3. Any portion of an entered CNC program can be played back and edited at will. Tool motions can be electronically displayed upon playback. ②