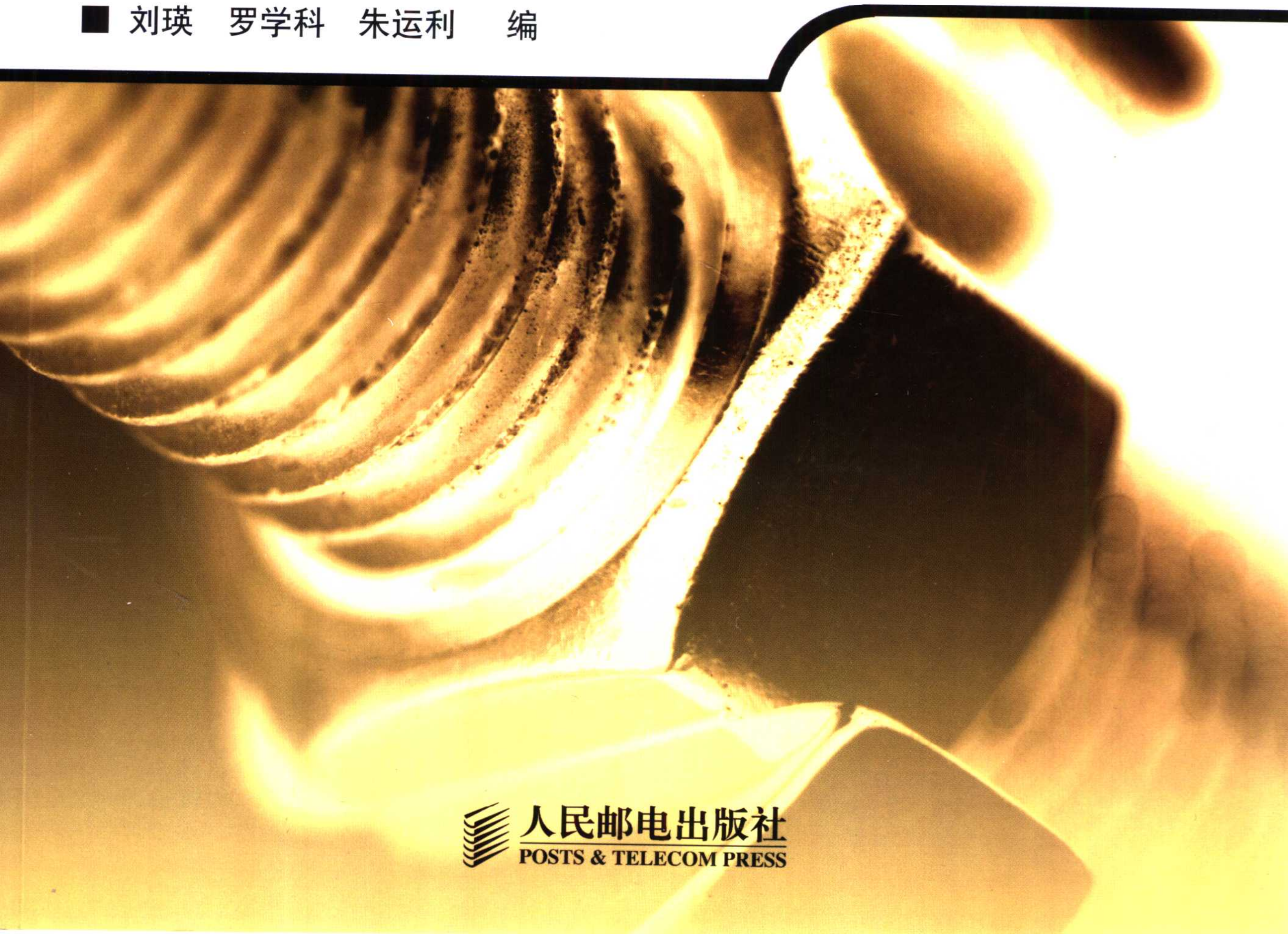
21世纪高等职业教育数控技术规划教材

数控技术专业英语

■ 刘瑛　罗学科　朱运利　编



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内 容 提 要

本书立足于现代制造业，针对数控技术精选了 14 个主题，用原汁原味的英语，全面、系统地描述了数控机床相关的各类信息。本书介绍了数控领域的最新技术和知识，以图文并茂的方式表达，通过专业知识帮助和促进英语水平的提高。课后习题着眼于专业知识，形式多样。

本书可作为高职高专院校数控专业的英语教材，也可以作为工程技术人员的自学参考书。

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21 世纪高等职业教育
数控技术规划教材编审委员会

从书前言

数控技术作为制造业实现自动化、柔性化、集成化生产的基础，是制造业提高产品质量和生产效率的重要手段，数控技术的应用水平更是体现国家综合国力的重要标志。加入WTO以后，中国正在逐渐成为“世界制造中心”，制造业已经成为国民经济的支柱产业。为了增强竞争能力，中国制造业开始更加广泛地使用先进的数控技术。然而，除了需要技术条件、政策环境和廉价劳动力等方面的支持外，企业更需要大批高素质的专门人才，特别是大批具有较高素质的数控技术应用型人才。人力市场上也因此出现数控技术应用型人才的严重短缺，而培养高素质的数控人才是高等职业教育义不容辞的责任。

为此，人民邮电出版社按照教育部、中国机械工业联合会等六部门关于高等职业教育数控技术应用专业领域技能型紧缺人才培养的一系列精神，专门针对数控行业现阶段的特点和要求，组织全国范围内高等职业院校中对数控技术应用专业教学和实践经验都非常丰富的教师、专家和在职企业人员成立了“21 世纪高等职业教育数控技术规划教材编审委员会”，就数控专业的课程体系结构的设置以及新型数控教材的编写进行了一系列研讨。从职业分析入手，对职业岗位进行能力分解，以技术应用能力和岗位工作技能为支撑，明确数控专业领域核心能力，并且围绕核心技能的培养形成数控专业领域的课程体系。其后，在全国广泛调研的基础上，再经过反复的讨论，决定编写出版《21 世纪高等职业教育数控技术规划教材》系列教材。

本系列教材的作者，由高等职业教育一线的优秀骨干教师和数控企业的技术人员所组成。这套教材体现了企业对数控人才的具体要求和学校多年的教育、教学经验的结合，并且力求文字表达的简练和知识内容的实用，希望能够最大限度地适合高等职业教学的要求。

高等职业教育改革和教材建设不是一朝一夕可以完成的，作为一项工程它需要反复地研讨和实践。我们衷心希望，全国关心高等职业教育的广大读者能够对本套教材的不当之处给予批评指正、提出修改意见；我们也热切盼望从事高等职业教育的教师、专家以及数控企业的技术专家和我们联系，共同探讨数控教学的课程组织方案和教材编写等相关问题。来信请发至 yangkun@ptpress.com.cn ，我们也殷切的期待您的投稿。

本系列教材在调研和编写过程中，得到了机械工业联合会数控专业教材指导委员会几位专家的大力帮助，在此表示衷心的感谢。

21 世纪高等职业教育数控技术规划教材编审委员会

前　言

制造业是国民经济的支柱产业，自20世纪50年代初第一台数控机床出现以来，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，涉及到许多相关领域、交叉学科。在这种背景下，培养掌握数控技术的高级技术应用型人才成为各高职高专院校的迫切任务。

本书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。相对传统的英语教材而言，这本教材更像一本英文版的数控专业教材——系统、全面、图文并茂地阐述了与数控机床相关的各类信息。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：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便可以揣摩出各段文字的大意，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，形式多样。

本书可作为高职高专院校数控专业英语教材，也可作为工程技术人员自学参考用书。

本书由北方工业大学刘瑛、罗学科和北京轻工职业技术学院朱运利编写，北方工业大学机电中心的徐宏海主任等为该书的编写提出了宝贵意见，在此表示感谢。

由于时间紧迫，书中难免有错误和不足之处，请读者发 Email 到 nengdouma@263.NET 给予批评和指正。

编者

2004年8月

Contents

Unit 1

Introduction to Computer Numerical Control Manufacturing

1.1 Introduction

After reading this unit, you should be able to:

1. Describe the history of numerical control.
2. Explain what computer numerical control (CNC) is and what basic components comprise CNC systems.
3. State the objectives and advantages concerning CNC use.

1.2 The History of Numerical Control

In 1945, at the end of World War II, several events led to an experiment that changed metal manufacturing.①

1945

In the early 1940s, the need to produce military products, such as airplanes, accelerated technical research. As a result, the products being produced at the end of the war were too complex in shape or too closely toleranced for practical manufacturing.②

To assist in engineering calculations, a computer was developed at the University of Pennsylvania. The ENIAC (Electrical Numerical Integrator and Calculator) as it was called, was a huge mass of tubes and wires. It was difficult to program and very slow by today's standards, but it was a computer.

Later, numerical control machines and computers were used to develop today's computer numerical control (CNC) machines. The Parsons Corporation, the United States Air Force, and the Massachusetts Institute of Technology each played a role in this development.

1946

In 1946, the Parsons Corporation tried to find accurate ways to make complicated aircraft parts. In an effort to generate an accurate rotor blade for a helicopter, they experimented with complicated tables of coordinates and manual machines.③ To generate the compound curves, they placed one human operator per axis handle, and called each move out in turn. This was slow and prone to errors. The Parsons Corporation then turned its attention to automatically generating these shapes. It seemed that an automatic method was possible.

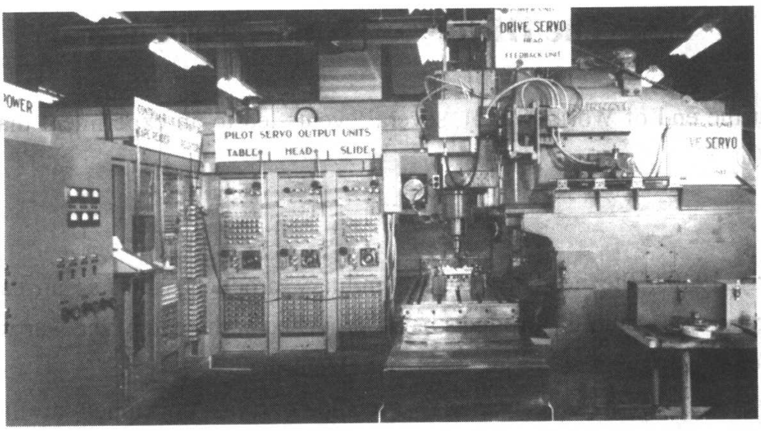
1949

John Parsons then set up a demonstration of his ideas for the Air Force. With a demonstration, Parsons convinced the Air Force to award a research contract.

1952

Shortly thereafter, Parsons set up a subcontract with the Servomechanisms Laboratory of the Massachusetts Institute of Technology (MIT). After three years, MIT built the first NC milling machine. In 1952, a vertical spindle milling machine ran the first true NC-produced parts. See Figure 1.1. The electrical cabinet took up more floor space than the machine. This was, however, the beginning that would change machining forever.

The prototype numerical control machine developed by MIT used a punched tape to generate movements of three axes. This machine was capable of making curved shapes, quickly, accurately, and reliably.



This is thought to be the first true NC machine (这是第一台真正的 NC 机床)

Figure 1.1

1955

In 1955, the Air Force of USA granted 35 million dollars to produce 100 NC machines. These were used to make military aircraft.

1960

In 1960, machine manufacturers began to make NC equipment that many companies could afford. In 1960, equipment was on the market at a price that allowed many shops to purchase their first NC machine.

Vocabulary

at the end of 在...结尾,在...末端
lead to 导致，通向
experiment [iks'perimənt] *n.* 实践，尝试；实验，试验
military ['militəri] *adj.* 军事的，军用的
accelerate [æk'seləreit] *v.* 加速，促进
as a result 结果
complex ['kɔmpleks] *adj.* 复杂的，合成的，综合的
closely ['kləuzli] *adv.* 精密地，严密地
tolerance ['tɔlərəns] *n.* 公差，宽容，容许量；*vt.* 给（机器部件等）规定公差
assist [ə'sist] *v.* 援助，帮助
Pennsylvania [pensil'veinjə] *n.* 宾夕法尼亚州（美国州名）
mass [mæs] *n.* 大多数，大量
tube ['tju:b] *n.* 管，管子，[英] 地铁，<美> 电子管，显像管
play a role in 在…中起重要作用
Massachusetts [,mæsə'tʃu:sits] *n.* 马萨诸塞州
complicated ['kɔmplikeitid] *adj.* 复杂的，难解的
rotor ['rəutə(r)] *n.* （电机的）转子，（直升机的）水平旋翼
blade [bleid] *n.* 刀刃，刀片
rotor blades 转子叶片
compound ['kɔmpaund] *adj.* 复合的
prone [prəun] *adj.* 倾向于
in turn 依次，轮流
set up 设立，竖立，架起，升起，装配，创（纪录），提出，开业
demonstration [,demәns'treiʃən] *n.* 示范，实证
convince [kən'vins] *vt.* 使确信，使信服
award [ə'wɔ:d] *vt.* 授予，判给 *n.* 奖，奖品
thereafter [ðεər'ɑ:ftə] *adv.* 其后，从那时以后
subcontract [sʌb'kɔntrækt] *n.* 转包合同
servomechanism ['sə:vən'mekənizəm]*n.* 伺服系统
cabinet ['kæbinit] *n.* 柜子
prototype ['prəutətaip] *n.* 原型
punched tape 穿孔纸带

grant [grɑːnt] *vt.* 同意，准予，承认

Notes

1. In 1945, at the end of World War II, several events led to an experiment that changed metal manufacturing.
   1945 年，二战末期，有几件事情导致（人们开始了在）改变金属加工（方法方面）的尝试。其中：that changed metal manufacturing 是宾语从句，用来修饰 experiment。用括号括起来的部分在原文中并未出现，之所以添加它们，是为了让句子更符合汉语的语言习惯。这种状况在本书的注释、翻译中会经常出现。
2. As a result, the products being produced at the end of the war were too complex in shape or too closely toleranced for practical manufacturing.
   结果，对于实际加工而言，战争末期（要求）制造的产品在形状方面过于复杂，或者对公差的要求过于精密了。其中：being produced 用来修饰 products，表示过去正被制造的产品。
3. In an effort to generate an accurate rotor blade for a helicopter, they experimented with complicated tables of coordinates and manual machines.
   为了精确制造出一个直升机的转子叶片，他们用具有复杂的多坐标的工作台与普通机床进行试验。

1.3 Numerical Control Definition, Its Concepts and Advantages

Numerical control has been used in industry for over 50 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:

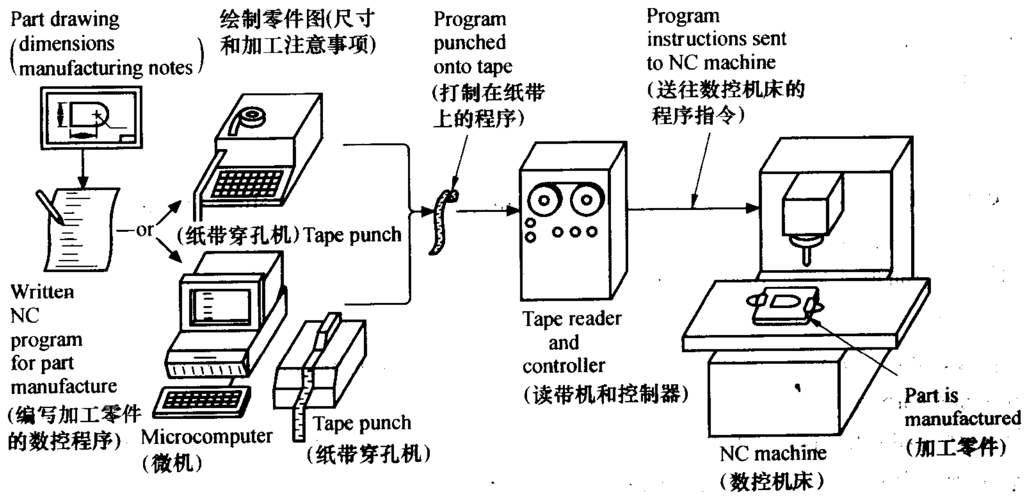
Tape punch: converts written instructions into a corresponding hole pattern, the hole pattern is punched into tape which passes through this device.② Much older units used a typewriter device called a Flexowriter. Newer devices include a microcomputer coupled with a tape punch unit.

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

See Figure 1.2.



Components of traditional NC systems（传统 NC 系统的组成）

Figure 1.2

NC systems offer some of the following advantages over manual methods of production:③

1. Better control of tool motions under optimum cutting conditions.
2. Improved part quality and repeatability.
3. Reduced tooling costs, tool wear, and job setup time.④
4. Reduced time to manufacture parts.
5. Reduced scrap.
6. Better production planning and placement of machining operations.⑤

Vocabulary

approach [ə'prəutʃ] *n.* 方法
corresponding [ˌkɔris'pɔndiŋ] *adj.* 相应的，一致的，符合的
be known as 被认为是
punch [pʌntʃ] *vt.* 打洞，打孔，猛击
convert [kən'və:t] *n., vt.* 转换，改变
pattern ['pætən] *n.* 模范，式样，方式
flexowriter ['fleksəˌraitə] *n.* 电传打字机
couple ['kʌpl] *vt.* 连合，连接，结合 *vi.* 结合，结婚 *n.* （一）对，（一）双，夫妇
subsequently ['sʌbsikwəntli] *adv.* 以后，后来
respond [ris'pɔnd] *v.* 回答，响应，作出反应

accordingly [ə'kɔːdiŋli] *adv.* 因此，于是，相应地，如前所说，适当地
spindle ['spindl] *n.* 主轴，轴
table ['teibl] *n.* 工作台
offer ['ɔfə] *vt.* 提供
optimum ['ɔptiməm] *adj.* 最佳的，最有利的，最适宜的
repeatability [ri,piːt ə'biliti] *n.* 可重复性
scrap [skræp] *n.* 废料，碎片
placement ['pleismənt] *n.* 安排，布置

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——编码。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. Tape punch：converts written instructions into a corresponding hole pattern, the hole pattern is punched into tape which passes through this device.
   纸带穿孔机：将写好的指令转换成相应的孔的形式，并将这些孔打制在穿过纸带穿孔机的纸带上。其中：which passes through this device 作为定语修饰 tape。
3. NC systems offer some of the following advantages over manual methods of production.
   相对手工制造而言，NC 系统具有下列优势。其中：A offer some advantages over B 是一个十分有用的句型，表示 A 比 B 具有某种优势。
4. 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
5. Better production planning and placement of machining operations.
   有利于作出更好的制造规划和加工操作安排。

1.4 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