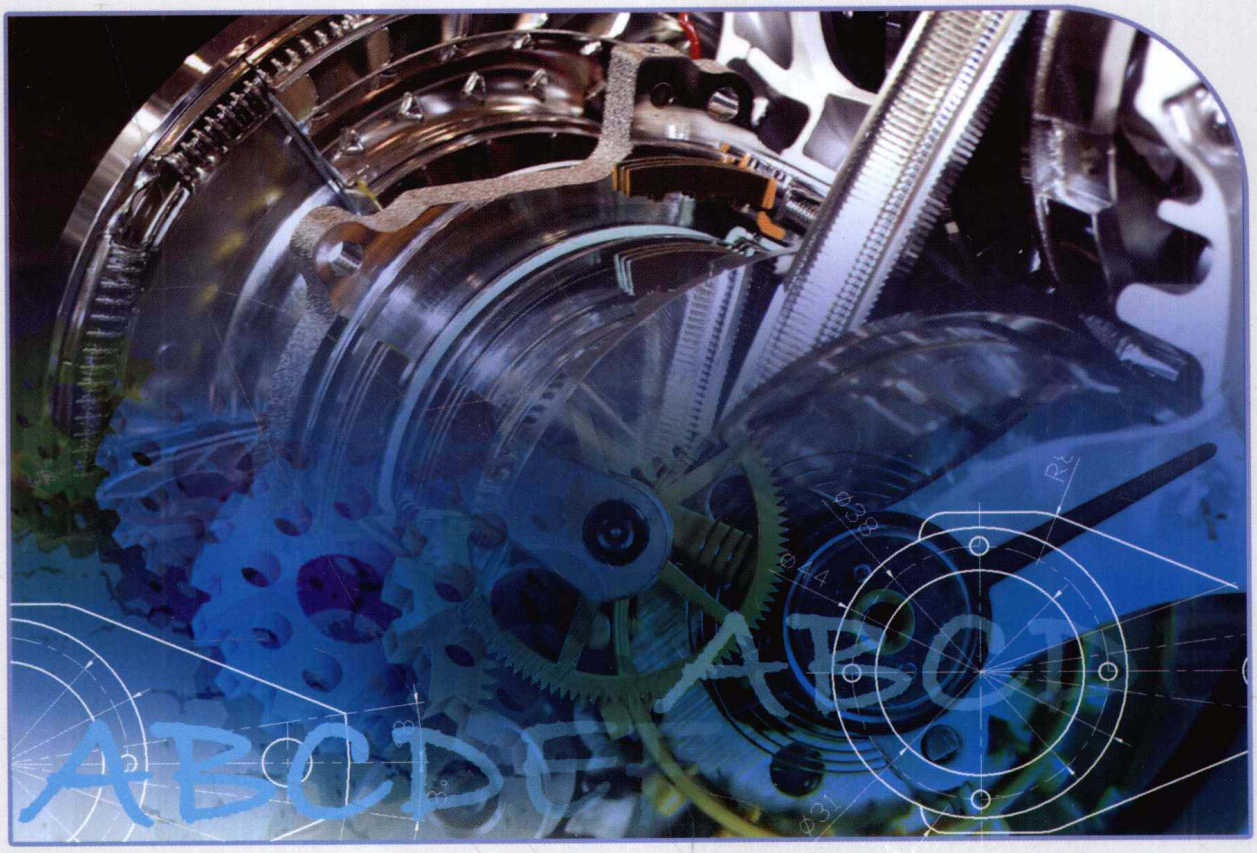
高等院校“十二五”精品课程建设成果



数控专业英语

SHUKONG ZHUANYE YINGYU

主编　赵金广

北京理工大学出版社
BEIJING INSTITUTE OF TECHNOLOGY PRESS

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内 容 简 介

本书为教育部高等教育示范专业规划教材，是高等院校“十二五”精品课程建设成果，旨在提高高等院校机械、数控类相关专业学生及从业人员的专业英语水平，以及涉外业务人员的交际能力。

本书依照高等教育培养目标及教学实际，紧抓学生学习心理特点，摈除了唯语法是从的观念和课文繁杂冗长、枯燥无味等缺点，适当降低了理论难度要求，缩短了课文篇幅，适当增加了插图说明。全书涵盖了数控及数控机床、数控编程、数控机床操作、数控机床故障诊断及维护、计算机辅助设计、柔性制造系统、特种加工、求职英语等方面的内容。

本书具有题材广泛、内容丰富、专业性和实用性强等特点。相比传统教材，增添了学习趣味性，一定程度上使读者更容易接受，便于教与学。

本书可作为高等院校机械、数控类及相近专业本科生的教材，也可供大专、成人教育有关专业选用，还可以作为企业培训教材。

图书在版编目（CIP）数据

数控专业英语/赵金广主编. —北京：北京理工大学出版社，2011.11
ISBN 978-7-5640-5288-1

Ⅰ. ①数…　Ⅱ. ①赵…　Ⅲ. ①数控机床-英语-高等学校-教材　Ⅳ. ①H31

中国版本图书馆 CIP 数据核字（2011）第 235515 号

出版发行／北京理工大学出版社
社　　址／北京市海淀区中关村南大街 5 号
邮　　编／100081
电　　话／(010)68914775(办公室)　68944990(批销中心)　68911084(读者服务部)
网　　址／http：// www. bitpress. com. cn
经　　销／全国各地新华书店
印　　刷／北京兆成印刷有限责任公司
开　　本／710 毫米×1000 毫米　1/16
印　　张／13.75
字　　数／228 千字
版　　次／2011 年 11 月第 1 版　　2011 年 11 月第 1 次印刷
印　　数／1～2000 册　　责任校对／周瑞红
定　　价／31.00 元　　责任印制／吴皓云

前　言

随着全球经济一体化进程的加快，国际科技、文化、经济交流日益紧密与频繁。科技的发展对高技能人才知识和能力的要求逐步提高，为了更好地学习先进的数控加工技术，加强交流，加快发展，具备较高的专业英语水平显得尤为重要。

本书是根据教育部数控技能型紧缺人才培养培训方案的指导思想和最新的数控专业教学计划编写的，为适应当前高等教育的特点，本书突出实用性，注重针对性。

本书是由高等院校的具有多年教学经验的“双师型”教师共同编写的一本实用性很强的专业英语教材。本书结合专业课程，围绕数控应用技术，全书共有9个单元，主要包括数控及数控机床、数控编程、数控机床操作、数控机床故障诊断及维护、计算机辅助设计、柔性制造系统、特种加工、求职英语等方面的内容。

本书编写特点如下：

（1）文章内容新颖，选材广泛，基本涵盖了数控加工等先进制造内容。

（2）课后有注释、习题、阅读材料，书后有习题答案、参考译文，便于读者自学。

（3）注重学习心理学，文章短小精悍、图文并茂、浅显易懂，体现了趣味性、知识性。

（4）实用性较强，不仅介绍数控加工等专业技术知识，而且详细介绍了求职实用英语。

本书由赵金广担任主编，费姝霞和吴康分别担任副主编。全书由赵金广统稿。曹维忠副教授担任了本书的主审。

本书博采众长，在编写的过程中广泛参阅了国内外相关专业的英语教材等资料。本书可作为高等院校机械类相关专业的教材，也可作为机械制造业及自动化领域有关技术人员或销售人员的参考书。

由于编者水平有限，书中难免有不妥之处，恳请读者批评指正。

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编　者

Contents

Unit 1 NC Technology

每课一句

Living without an aim is like sailing without a compass. (Alexandre Dumas, French writer) 生活没有目标就像航海没有指南针。——法国作家大仲马

Lesson 1 The Benefits and Advantages of NC

Numerical control (NC) is a form of programmable automation in which the processing equipment is controlled by means of numbers, letters, and other symbols. The numbers, letters, and symbols are coded in an appropriate format to define a program of instructions for a particular workpiece. When the job is changed, the program of instructions will be changed. The capability to change the program is what makes NC suitable for low and medium-volume production. It is much easier to write programs than to make major alterations of the processing equipment.

NC has had a significant effect on the industrial world since the first Industrial Revolution. The developments in computer and NC have extended a person's minds and muscles. NC technology has made such rapid advances that it is being used in almost every area of manufacturing, such as machining, welding, press-working, and assembly.

Benefits: Numerical control has been in use for almost 40 years. Since its inception, it has been improved continually. Each improvement has added a new benefit or improved an existing system of NC as compared with traditional manual machine operation. During this period, a body of knowledge has developed from the actual benefits that can be derived from NC. There is a general consensus among manufacturing professionals: Benefits derived from NC are as follows: better planning; greater-flexibility; easier scheduling; less setup, lead, and processing time; better machine utilization; lower overall tooling costs; greater uniformity in cutting; greater accuracy in cutting; a higher degree of interchangeability of parts and tools;

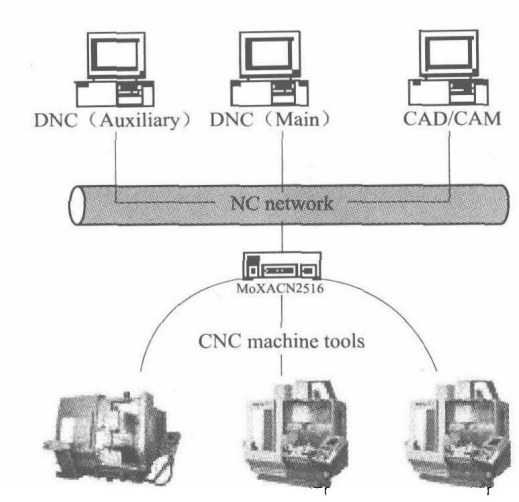

Fig. 1-1 A network structure form of DNC

more accurate cost estimates; permanent memory of how a part was made.

These are the same types of benefits generally associated with any manufacturing process that has successfully moved from a manual format to a fully or partially automated one. The extent of the benefit depends on how successfully the transition has been carried out and how well developed the associated technologies have become.

With the advent of DNC (Fig. 1-1), and CNC in numerical control, all of the benefits listed above have evolved into bona fide, documentable benefits.

Advantages: NC reduces the amount of non-chip-producing time by selecting speeds and feeds, making rapid moves between surfaces to be cut, using automatic fixtures, automatic tool changing, controlling the coolant, in-process gaging, and loading and unloading the part. Some of the major advantages of NC are as follows:

(1) There is automatic or semiautomatic operation of machine tools. The degree of automation can be selected as required.

(2) Flexible manufacturing of parts is much easier. Only the tape needs changing to produce another part.

(3) Storage space is reduced. Simple workholding fixtures are generally used, reducing the number of jigs or fixtures which must be stored.

(4) Small part lots can be run economically. Often a single part can be produced more quickly and better by NC.

(5) Nonproductive time is reduced. More time is spent on machining the part, and less time is spent on moving and waiting.

(6) Tooling costs are reduced. In most cases complex jigs and fixtures are not required.

(7) Inspection and assembly costs are lower. The quality of the product is improved, reducing the need for inspection and ensuring that parts fit as required.

(8) Time of machine utilization is increased. There is less time that a machine tool is idle because workpiece and tool changes are rapid and automatic.

(9) Complex forms can easily be machined. The new control unit features and programming capabilities make the machining of contours and complex forms very

easy.

(10) Parts inventory is reduced. Parts can be made as required from the information on the punched tape.

Words and Expressions

benefit	[ˈbenifit]	*n.*	利益，好处
automation	[ˌɔːtəˈmeiʃən]	*n.*	自动化；自动操作
semiautomatic	[ˈsemiˌɔːtəˈmætik]	*a.*	半自动的
appropriate	[əˈprəupriit]	*a.*	适当的
format	[ˈfɔːmæt]	*n.*	格式；版式
workpiece	[ˈwəːkpiːs]	*n.*	工件；轧件
capability	[ˌkeipəˈbiliti]	*n.*	才能，能力；容量
alteration	[ˌɔːltəˈreiʃən]	*n.*	修改，改变；变更
significant	[sigˈnifikənt]	*a.*	重大的；有效的；有意义的
revolution	[ˌrevəˈluːʃən]	*n.*	革命
muscle	[ˈmʌsl]	*n.*	肌肉；力量
welding	[ˈweldiŋ]	*n.*	焊接
assembly	[əˈsembli]	*n.*	装配；集会，集合
inception	[inˈsepʃən]	*n.*	起初；开始
consensus	[kənˈsensəs]	*n.*	一致；舆论；共识
flexibility	[ˌfleksiˈbiliti]	*n.*	灵活性；弹性；适应性
utilization	[ˌjuːtilaiˈzeiʃən]	*n.*	利用，使用
interchangeability	[ˈintəˌtʃeindʒəˈbiliti]	*n.*	可交换性，可交替性
jig	[dʒig]	*n.*	夹具
fixture	[ˈfikstʃə]	*n.*	设备；固定装置
coolant	[ˈkuːlənt]	*n.*	冷却剂
nonproductive	[ˈnɔnˌprəˈdʌktiv]	*a.*	非生产性的；非加工的
inventory	[ˈinvəntəri]	*n.*	存货，存货清单
workholding			工件夹紧
effect on			对……的作用
as compared with			与……相比
be derived from			来自，源自于
cost estimate			成本估算，成本估计
DNC (Direct Numerical Control)			直接数控

in-process gaging	在线检测
non-chip-producing time	非切削时间
tool change	换刀

Notes

NC reduces the amount of non-chip-producing time by selecting speeds and feeds, making rapid moves between surfaces to be cut, using automatic fixtures, automatic tool changing, controlling the coolant, in-process gaging, and loading and unloading the part.

“NC reduces... by”中的“by”表示“靠”（某种方法与手段）。

例句：Some recognize others by the way they walk or by their voice.

一些人靠别人走路的姿势或说话的声音来识别。

Exercises

Ⅰ. Translate the following words into English or Chinese.

成本估算 _____

DNC _____

在线检测 _____

non-chip-producing time _____

换刀 _____

Ⅱ. Translate the following sentences into Chinese.

1. The capability to change the program is what makes NC suitable for low and medium-volume production.
2. NC has had a significant effect on the industrial world since the first Industrial Revolution.
3. Each improvement has added a new benefit or improved an existing system of NC as compared with traditional manual machine operation.
4. These are the same types of benefits generally associated with any manufacturing process that has successfully moved from a manual format to a fully or partially automated format.
5. Tooling costs are reduced. In most cases complex jigs and fixtures are not required.

每课一句

There is no royal road to science, and only those who do not dread the fatiguing climb of gaining its numinous summits. (Karl Marx, German revolutionary) 在科学上没有平坦的大道，只有不畏劳苦沿着其崎岖之路攀登的人，才有希望达到它光辉的顶点。——德国革命家马克思

Lesson 2 Brief Introduction to CNC

Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. CNC can control the motions of the workpiece or tool, the input parameters such as feed, depth of cut, speed, and the functions such as turning spindle on/off, turning coolant on/off.

A CNC system consists of three basic components (Fig. 1-2):

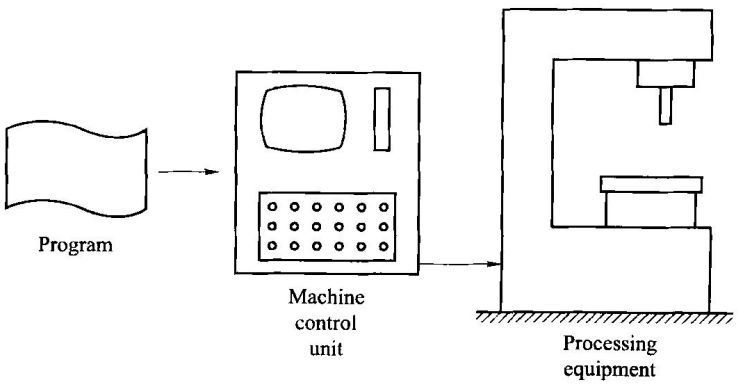

Fig. 1-2 Basic components of a CNC system

1. Part program

The program of instructions is a kind of numerical or symbolic codes that is detailed step by step to tell the machine tool what to do. Think of giving any series of step-by-step instructions. A CNC program is nothing more than another kind of instruction set. It's written in sentence-like format and the control will execute it in sequential order, step by step. A special series of CNC words are used to communicate what the machine is intended to do. CNC words begin with letter addresses (like *F* for feedrate, *S* for spindle speed, and *X*, *Y* & *Z* for axis motion). When placed together in a logical way, a group of CNC words make up a command that resembles a sentence.

2. Machine control unit (MCU)

The controller unit is the unit that reads the programme of instructions and converts it to real movement of a machine tool. The CNC control will interpret a CNC program and activate the series of commands in sequential order. As it reads the program, the CNC control will activate the appropriate machine functions, cause axis motion, and in general, follow the instructions given in the program. Along with interpreting the CNC program, the CNC control has several other purposes. All current model CNC controls allow programs to be modified (edited) if mistakes are found. The CNC control allows special verification functions (like dry run) to confirm the correctness of the CNC program. The CNC control allows inputs separated from the program by certain important operators, like tool length values. In general, the CNC control allows all functions of the machine to be manipulated.

In addition, three basic types of control unit are used with NC machine: open-loop control, semi-closed loop control and closed loop control.

3. Machine tool

The machine tool performs the mechanical work and deals directly with the part being machined.

Applications of CNC include non-machine tool areas as well as machine tool areas. In the machine tool category, CNC is widely used for lathe, drill press, milling machine, grinding unit, laser, sheet-metal press working machine, tube bending machine, etc. Highly automated machine tools such as turning center and machining center which change the cutting tools automatically under CNC control have been developed.

Words and Expressions

resemble	[riˈzembl]	*v.*	类似，像
convert	[kənˈvəːt]	*v.*	(使) 转变；(使) 转换
interpret	[inˈtəːprit]	*v.*	说明；口译
sequential	[siˈkwenʃəl]	*a.*	连续的
verification	[ˌverifiˈkeiʃən]	*n.*	确认，查证；核实
correctness	[kəˈrektnis]	*n.*	正确性
manipulate	[məˈnipjuleit]	*v.*	操纵；操作
category	[ˈkætigəri]	*n.*	种类，分类
laser	[ˈleizə]	*n.*	激光

bending	['bendiŋ]	*n.*	弯曲；折弯
step by step			逐步地
machine control unit (MCU)			机床控制装置
in general			一般而言
in addition			另外，此外
open-loop			开环
semi-closed loop			半闭环
turning center			车削中心
machining center			加工中心

Notes

[1] A CNC program is nothing more than another kind of instruction set.

句中“nothing more than”意思是“不过是，无非是”。

例如：We are describing nothing more than mere milliseconds, but there is a delay nonetheless.

我们描述的虽不过是几毫秒的事，但这仍然是一种时间延迟。

[2] Applications of CNC include non-machine tool areas as well as machine tool areas.

句中“as well as”的意思是“同……一样（也），和，也，还”。

This winter, see if you can hear how the season transforms sound, as well as the scenery.

这个冬天看看你能不能聆听到季节像改变景色一样改变了声音。

[3] In general, the CNC control allows all functions of the machine to be manipulated.

句中“to be manipulated”的意思是“被操纵”，做后置定语修饰“machine”。

例如：Open the image to be manipulated.

打开那幅受控的图像。

Exercises

Ⅰ. Translate the following words into English.

机床控制装置 _____

开环控制 _____

半闭环控制 _____

车削中心 _____

加工中心 _____

Ⅱ. Fill in the blanks with the words given below.

A. step by step; B. more than; C. by means of; D. interpret;
E. make up; F. as well as; G. along with

1. Computer numerical control is one in which the functions and motions of a machine tool are controlled ( ) a prepared program containing coded alphanumeric data.
2. The program of instructions is a kind of numerical or symbolic codes that is detailed ( ) to tell the machine tool what to do.
3. A CNC program is nothing ( ) another kind of instruction set.
4. When placed together in a logical method, a group of CNC words ( ) a command that resembles a sentence.
5. The CNC control will ( ) a CNC program and activate the series of commands in sequential order.
6. ( ) interpreting the CNC program, the CNC control has several other purposes.
7. The applications of CNC include machine tool areas ( ) non-machine tool areas.

每课一句

Where there is a will, there is a way. (Thomas Edison, American inventor) 有志者，事竟成。——美国发明家爱迪生

Lesson 3 NC Technology Development Trends

With the rapid development of computer technology, the traditional manufacturing industries have transformed thoroughly, and the industrial developed countries spent huge sums of money on the modern manufacturing technology research and development to create a new model. In modern manufacturing systems, CNC technology is the key to technology, which combines microelectronics, computers, information processing, automatic detection and automatic control. It has such characteristics as high-precision, high-efficiency and flexible automation, which plays the pivotal role in the flexible automation, integration, intelligence of the manufacturing industry. Development trends of NC technology are as follows:

1. Performance development direction

(1) High-speed, high-precision and high-efficiency.

Speed, accuracy and efficiency of machinery manufacturing technology is the key performance indicators.

(2) Flexibility.

Flexibility includes two aspects: flexibility of CNC system itself and flexibility of group control system.

(3) Process complexity and multi-axis.

Process complexity of NC machine tools refers to it that, after the workpiece is loaded in a single machine on a fixture, multi-surface machining compound production is accomplished through such measures as changing tool automatically, rotating spindle head or turntable. Siemens 880-axis Control System, a kind of axis of CNC technology, can control up to 24 axes.

(4) Real-time intelligence.

With the development of science and technology, the real-time system and artificial intelligence are combined with each other, and the artificial intelligence is advancing towards real-time-response and more realistic fields, and the real-time system is also advancing towards the more complex application with intelligent behavior, which results in the new field of real-time intelligent control.

2. Functional development direction

(1) Graphical user interface.

User interface is the interface of dialogues between CNC systems and the user.

(2) Visualization in scientific computing.

Visualization in scientific computing can be used for efficient processing and interpretation of data, so that the exchange of information can directly use visual information of graphics, images and animation rather than limit to the use of words and languages.

(3) Diversification of interpolation and compensation.

Various interpolation methods include multiple linear interpolation, circular interpolation, cylindrical interpolation, space elliptical surface interpolation, thread interpolation, polar coordinate interpolation, 2D + 2 helical interpolation, NANO interpolation, interpolation NURBS (non-uniform rational B-spline interpolation), spline interpolation (A, B, C types) and polynomial interpolation, etc.

(4) Built-in high performance PLC.

Built-in high performance PLC module of CNC system can be directly programmed with ladder diagrams or advanced languages, and has intuitive online

debugging and online aid functions.

(5) Application of multimedia technology.

Multimedia technology is the combination of computers, audio-visual and communication technology, enabling computers to process voices, texts, images and video information comprehensively.

3. Development of the systematic structure

(1) Integration.

(2) Modularization.

(3) Networking.

(4) General open and closed-loop control mode.

Words and Expressions

traditional	[trəˈdiʃənəl]	*a.*	传统的；惯例的
fundamental	[ˌfʌndəˈmentəl]	*a.*	基本的，根本的
manufacturing	[ˌmænjuˈfæktʃəriŋ]	*a.*	制造的；制造业的
combine	[kəmˈbain]	*v.*	（使）化合；（使）联合，（使）结合
microelectronic	[ˌmaikrəuiˌlekˈtrɔnik]	*a.*	微电子的
integration	[ˌintiˈgreiʃən]	*n.*	集成；综合
high-precision	[ˈhaipriˈsiʒən]	*a.*	高精密度的
single	[ˈsiŋgl]	*a.*	单一的；单身的；单程的
turntable	[ˈtəːnˌteibl]	*n.*	转盘；转台
real-time	[ˈriəltaim]	*a.*	实时的
artificial	[ˌɑːtiˈfiʃəl]	*a.*	人造的；仿造的
visualization	[ˌvizjuəlaiˈzeiʃən]	*n.*	形象化；可视化
interpretation	[inˌtəːpriˈteiʃən]	*n.*	解释；翻译
interpolation	[inˌtəːpəuˈleiʃən]	*n.*	插入；插补
spline	[splain]	*n.*	样条曲线
polynomial	[ˌpɔliˈnəumiəl]	*a.*	多项式的
elliptical	[iˈliptikəl]	*a.*	椭圆的；省略的
helical	[ˈhelikəl]	*a.*	螺旋形的
thread	[θred]	*n.*	线；螺纹
debugging	[diˈbʌgiŋ]	*n.*	调试
audio-visual	[ˈɔːdiəuˈviʒuəl]	*a.*	视听的；视听教学的