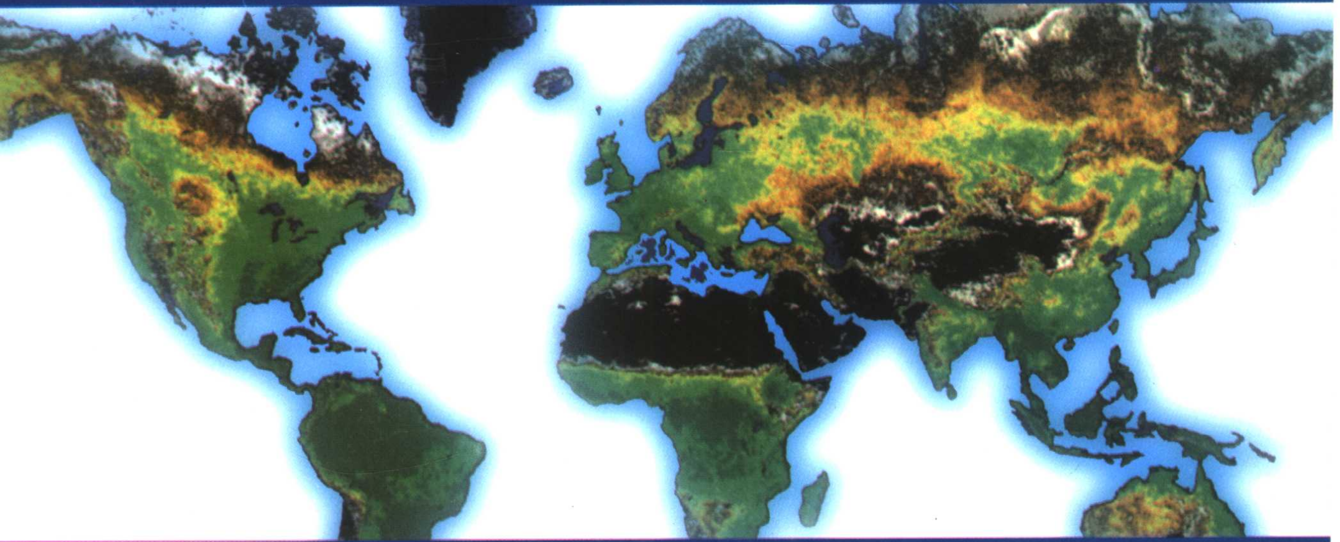
GEO-SPATIAL INFORMATION SCIENCE

高等学校测绘工程系列教材

测绘工程专业英语

English for Geomatics Engineering

尹 晖 主编



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编委：陈 庭 张小红 张松林
李 妍 徐晓华

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内容提要

本书是为测绘工程专业学生编写的专业英语教材，共分为四大部分。内容覆盖了测绘工程专业所涉及的各个领域，包括工程测量、大地测量、摄影测量、遥感以及地理信息系统等的基本概念、基本理论和基本术语以及当代最新的测绘技术。在国际学术交流部分精心选编了与测绘有关的国际学术组织、国际学术期刊和知名测绘仪器厂商的简要介绍。最后，简述了科技英语论文写作和翻译技巧的有关知识。

本书可作为高等学校测绘工程专业及相关专业本科和研究生的专业英语教材，双语教学的参考教材，也可作为相关专业工程技术人员学习科技英语之用。

前　　言

测绘工程专业英语是根据国家教育部规定，高等学校测绘工程专业本科学生在完成大学英语基础阶段学习之后，进入专业课程学习阶段，为提高专业英语文献阅读能力的需要而开设的必修课程。

为了跟踪学科的国际发展前沿，推动测绘学科课程教学与国际接轨，培养具有国际竞争能力的测绘高级人才，本书在编写上具有以下特点：

(1) 内容覆盖面较广，涉及了测绘工程专业各个领域，包括工程测量、大地测量、摄影测量、遥感以及地理信息系统等的基本概念、基本理论和基本术语，以及当代最新的测绘技术。

(2) 考虑语言学习的纯正性与规范性，课文主要选自近期出版发表的国外原版教材、论文、期刊和网络资源。

(3) 教材内容的组织采用归纳、简写和汇编相结合的方式，既注重专业知识的基础性、广泛性与先进性，同时也顾及专业知识与英语学习的互补与提高。

(4) 通过对测绘相关国际学术组织、国际权威杂志、知名测绘仪器公司、常用数学符号及公式表达、科技英语论文写作与翻译技巧的简要介绍，进一步拓宽学生视野，培养国际学术交流的能力。

本书由尹晖担任主编，编写了第一、第三部分和第二十五、三十八、三十九单元，并负责全书的组织、设计和统稿。本书的第三十二、三十三单元由陈庭编写；第二十、二十一、三十、三十一、三十七单元由张小红编写；第二十三、二十四、二十六单元由张松林编写；第二十七、二十八、二十九单元由李妍编写；第二十二单元由徐晓华编写；课文生词和专业术语由朱靖编录。

本书是武汉大学“十五”规划教材，是根据武汉大学测绘工程专业最新的教学大纲和教学计划编写而成，在编写过程中，得到了测绘学院许多老师的热情帮助和相关学术机构、测绘、仪器公司的大力支持。他们提出了许多宝贵的意见和建议，在此谨致以衷心的感谢。

限于我们的水平，书中难免有不当之处，恳请读者批评指正。

编　者

2004 年 12 月

Table of Contents

Part Ⅰ

Basic Knowledge in Geomatics Engineering

Unit 1 What is Geomatics?

Geomatics Defined

Where does the word Geomatics come from? GEODESY + GEOINFORMATICS = GEOMATICS or GEO- for earth and -MATICS for mathematical or GEO- for Geoscience and -MATICS for informatics. It has been said that geomatics is many things to many people. The term geomatics emerged first in Canada and as an academic discipline; it has been introduced worldwide in a number of institutes of higher education during the past few years, mostly by renaming what was previously called "geodesy" or "surveying", and by adding a number of computer science- and/ or GIS-oriented courses. Now the term includes the traditional surveying definition along with surveying steadily increased importance with the development of new technologies and the growing demand for a variety of spatially related types of information, particularly in measuring and monitoring our environment. Increasingly critical are areas of expanding populations, appreciating land values, dwindling natural resources, and the continuing stressing of the quality of our land, water and air from human activities. As such, geomatics bridges wide arcs from the geosciences through various engineering sciences and computer sciences to spatial planning, land development and the environmental sciences. Now the word geomatics has been adopted by several international bodies including the International Standards Organization (ISO), so it is here to stay.

The term "surveyor" is traditionally used to collectively describe those engaged in the above activities. More explicit job descriptions such as Land Surveyor, Engineering Surveyor or Hydrographic Surveyor for example, are commonly used by practitioners to more clearly describe and market their specialized expertise.

The term geomatics is a recent creation to convey the true collective and scientific nature of these related activities and has the flexibility to allow for the incorporation of future technological developments in these fields. Adoption of the term also allows a coherent marketing of the profession to industry and schools on a worldwide basis. As a result, both course and award titles in the traditional Land Surveying sector at many of the world's leading universities are being changed to "Degree in Geomatics". This does not suggest the demise of the term "surveyor" and graduates will still practice as land surveyors or photogrammetrists, etc. as appropriate to their specialization.

In the last decade, there has been dramatic development and growth in the use of hardware and software solutions to both measure and process geo-spatial data. This has created and will continue to create new areas of application, with associated job opportunities for suitably qualified graduates. As a result, the role of the "surveyor" is expanding beyond traditional areas of practice, as described above, into new areas of opportunity. In addition, recent advances in the technology of data collection and processing have blurred the boundaries of practice and activity between what were previously regarded as related but separate areas. Such developments are forecast to continue and will create new career paths for graduates whose education and training is broadly based and of a high academic standard.

To enable graduates to take full advantage of these developments, significant changes in education and training are required. Academic and professional institutions are also responding, in part, by adopting the term geomatics both as a course and as an award title. A working definition of geomatics, which reflects current thinking and predicted change, is:

> *The science and technology of acquiring, storing, processing, managing, analyzing and presenting geographically referenced information (geo-spatial data). This broad term applies both to science and technology, and integrates the following more specific disciplines and technologies including surveying and mapping, geodesy, satellite positioning, photogrammetry, remote sensing, geographic information systems (GIS), land management, computer systems, environmental visualization and computer graphics.*

Several terms such as "geomatics," "geomatic engineering," and "geoinformatics" are now in common use pertaining to activities generally concerned with geographic information. These terms have been adopted primarily to represent the general approach that geographic information is collected, managed, and applied. Along with land surveying, photogrammetry, remote sensing, and cartography, GIS is an important component of geomatics.

Branches of Geomatics

Data acquisition techniques include field surveying, global positioning system (GPS), satellite positioning, and remotely sensed imagery obtained through aerial photography and satellite imagery. It also includes the acquisition of database material scanned from older maps and plans and data collected by related agencies.

Data management and process are handled through the use of computer programs for engineering design, digital photogrammetry, image analysis, relational data base management, and geographic information systems (GIS). Data plotting (presentation) is handled through the use of mapping and other illustrative computer programs; the presentations are displayed on computer screens (where interactive editing can occur) and are output on paper from digital plotting devices.

Once the positions and attributes of geographic entities have been digitized and stored in computer memory, they are available for use by a wide variety of users. Through the use of modem information technology (IT), geomatics brings together professionals in the following disciplines: surveying, mapping, remote sensing, land registration, civil and marine engineering, forestry, agriculture, planning and development, geology, geographical sciences, infrastructure management, navigation, environmental and natural resources monitoring, and computer science.

Other Definitions of Geomatics

As defined by the Canadian Institute of Geomatics in their quarterly journal "*Geomatica*": **Geomatics** is a field of activities which, using a systemic approach, integrates all the means used to acquire and manage spatial data required as part of scientific, administrative, legal and technical operations involved in the process of the production and management of spatial information.

The definition of **Geomatics** is evolving. A working definition might be "the art, science and technologies related to the management of geographically-referenced information." Geomatics includes a wide range of activities, from the acquisition and analysis of site-specific spatial data in engineering and development surveys to the application of GIS and remote sensing technologies in environmental management. It includes cadastral surveying, hydrographic surveying, and ocean mapping, and it plays an important role in land administration and land use management.

Geomatics is the modern scientific term referring to the integrated approach of measurement, analysis, management, storage and display of the descriptions and location of Earth-based data, often termed spatial data. These data come from many sources, including earth orbiting satellites, air and sea-borne sensors and ground based instruments. It is processed and manipulated with state-of-the-art information technology using computer software and hardware. It has applications in all disciplines which depend on spatial data, including environmental studies, planning, engineering, navigation, geology and geophysics, oceanography, land development and land ownership and tourism. It is thus fundamental to all the geoscience disciplines which use spatially related data.

[from the School of Geomatic Engineering, Univ. of New South Wales]

Geomatics is concerned with the measurement, representation, analysis, management, retrieval and display of spatial data concerning both the Earths physical features and the built environment. The principal disciplines embraced by Geomatics include the mapping sciences, land management, geographic information systems, environmental visualisation, geodesy, photogrammetry, remote sensing and surveying.
[from the Dept. of Geomatics at Univ. of Melbourne]

Geomatics comprises the science, engineering, and art involved in collecting and managing geographically-referenced information. Geographical information plays an important role in activities such as environmental monitoring, management of land and marine resources, and real estate transactions.
[from the Dept. of Geodesy and Geomatics Engineering at UNB]

The science of **Geomatics** is concerned with the measurement, representation, analysis, management, retrieval and display of spatial information describing both the Earth's physical features and the built environment. Geomatics includes disciplines such as:
Surveying, Geodesy, Remote Sensing & Photogrammetry, Cartography, Geographic Information Systems, Global Positioning Systems.
[from the Dept. of Surveying and Spatial Information Science at the Univ. of Tasmania]

Words and Expressions

geoscience [ˌdʒi(ː)əu'saiəns] *n*. 地球科学
informatics [ˌinfə'mætiks] *n*. 信息学,情报学
monitor ['mɔnitə] *vt*. 监控 *n*. 监测,监视,控制,追踪,监控器
appreciate [ə'priːʃieit] *vi*. 增值,涨价 *vt*. 赏识,鉴赏,感激
dwindle ['dwindl] *v*. 缩小
ISO(International Standardization Organization) ['aisəu] *abbr*. 国际标准化组织
explicit [iks'plisit] *adj*. 清楚的,外在的,直率的,(租金等)直接付款的
hydrographic [ˌhaidrəu'græfik] *adj*. 与水道测量有关的,与水文地理有关的
hydrographic survey 海道测量,水道测量
practitioner [præk'tiʃənə] *n*. 从业者,开业者
expertise [ˌekspə'tiːz] *n*. 专门技术,专家的意见
flexibility [ˌfleksə'biliti] *n*. 适应性,机动性,挠性
incorporation [inˌkɔːpə'reiʃən] *n*. 结合,合并;形成法人组织,组成公司(或社团)
coherent [kəu'hiərənt] *adj*. 一致的,连贯的
demise [di'maiz] *n*. 死亡,让位,禅让 *vt*. 让渡,遗赠,转让
blur [bləː] *v*. 把(界线,视线等)弄得模糊不清,涂污,污损(名誉等),弄污

visualization [ˌviʒjuəlaiˈzeiʃən] *n*. 可视化，清楚地呈现
pertaining [pə(:)ˈteiniŋ] *adj*. 与…有关系的，附属…的，为…固有的(to)
imagery [ˈimidʒəri] *n*. 肖像(总称)，雕刻影像
plotting [ˈplɔtiŋ] *n*. 标图，测绘
illustrative [ˈiləstreitiv] *adj*. 说明性的，例证性的
entity [ˈentiti] *n*. 实体
digitize [ˈdidʒitaiz] *v*. [计]将资料数字化
registration [ˌredʒisˈtreiʃən] *n*. 注册，报到，登记
forestry [ˈfɔristri] *n*. 林产，森林地，林学
geology [dʒiˈɔlədʒi] *n*. 地质学，地质概况
geographical [ˌdʒiəˈgræfikəl] *adj*. 地理学的，地理的
infrastructure [ˈinfrəstrʌktʃə] *n*. 基础下部组织，下部构造
navigation [ˌnæviˈgeiʃən] *n*. 导航，航海，航空，领航，航行
quarterly [ˈkwɔːtəli] *adj*. 一年四次的，每季的
evolve [iˈvɔlv] *v*. (使)发展，(使)进展，(使)进化
cadastre [kəˈdæstə(r)] *n*. 地籍簿，地籍，地籍图
cadastral surveying 地籍测量
sensor [ˈsensə] *n*. 传感器
manipulate [məˈnipjuleit] *vt*. (熟练地)操作，使用(机器等)，操纵(人或市价、市场)，利用
state-of-the-art 发展现状，技术发展现状
geophysics [ˌdʒi(:)əuˈfiziks] *n*. 地球物理学
oceanography [ˌəuʃiəˈnɔgrəfi] *n*. 海洋学
retrieval [riˈtriːvəl] *n*. 检索，恢复，修补，重获
embrace [imˈbreis] *vt*. 拥抱，互相拥抱，包含，收买，信奉 *vi*. 拥抱 *n*. 拥抱

Terms Highlights

geomatics 测绘学
geodesy 大地测量学
surveying and mapping 测绘
photogrammetry 摄影测量学
remote sensing (RS) 遥感
global positioning system (GPS) 全球定位系统
satellite positioning 卫星定位
geographic information systems (GIS) 地理信息系统
land management 土地管理
computer graphics 计算机图形学

Unit 2 Geodetic Surveying and Plane Surveying

Surveying has been traditionally defined as the art and science of determining the position of natural and artificial features on, above or below the earth's surface; and representing this information in analog form as a contoured map, paper plan or chart, or as figures in report tables, or in digital form as a three dimensional mathematical model stored in the computer. As such, the surveyor/geodesist dealt with the physical and mathematical aspect of measurement. The accurate determination and monumentation of points on the surface of the Earth is therefore seen as the major task. Though these surveys are for various purposes, still the basic operations are the same — they involve measurements and computations or, basically, fieldwork and office work. There are many different types of surveys such as land surveys, route surveys, city surveys, construction surveys, hydrographic surveys, etc., but generally speaking, surveying is divided into two major categories: geodetic and plane surveying. Surveys will either take into account the true shape of the Earth (Geodetic surveys) or treat the earth as a flat surface (Plane surveys). Additionally, surveys are conducted for the purpose of positioning features on the ground (Horizontal surveys), determining the elevation or heights of features (Vertical surveys) or a combination of both.

Geodetic Surveying

The type of surveying that takes into account the true shape of the earth is called *geodetic surveying*. This type of survey is suited for large areas and long lines and is used to find the precise location of basic points needed for establishing control for other surveys. In geodetic surveys, the stations are normally long distances apart, and more precise instruments and surveying methods are required for this type of surveying than for plane surveying.

Widely spaced, permanent monuments serve as the basis for computing lengths and distances between relative positions. These basic points with permanent monuments are called geodetic control survey points, which support the production of consistent and compatible data for surveying and mapping projects. In the past, ground-based theodolites, tapes, and electronic devices were the primary geodetic field measurements used. Today, the technological expansion of GPS has made it possible to perform extremely accurate geodetic surveys at a fraction of the cost. A thorough knowledge of the principles of geodesy is an absolute prerequisite for the proper planning and execution of geodetic surveys.

In Geodetic Surveys, the shape of the earth is thought of as a spheroid, although in a technical sense, it is not really a spheroid. Therefore, distances measured on or near the surface of the earth are not along straight lines or planes, but on a curved surface. Hence, in the computation of distances in geodetic surveys, allowances are made for the earth's minor and major diameters from which a spheroid of reference is developed. The position of each geodetic station is related to this spheroid. The positions are expressed as latitudes (angles north or south of the Equator) and longitudes (angles east or west of a prime meridian) or as northings and eastings on a rectangular grid.

A geodetic survey establishes the fundamentals for the determination of the surface and gravity field of a country. This is realized by coordinates and gravity values of a sufficiently large number of control points, arranged in geodetic and gravimetric networks. In this fundamental work, curvature and the gravity field of the earth must be considered.

Plane Surveying

The type of surveying in which the mean surface of the earth is considered a plane, or in which the curvature of the earth can be disregarded without significant error, generally is called *plane surveying*. The term is used to designate survey work in which the distances or areas involved are of limited extent. With regard to horizontal distances and directions, a level line is considered mathematically straight, the direction of the plumb line is considered to be the same at all points within the limits of the survey, and all angles are considered to be plane angles.

To make computations in plane surveying, you will use formulas of plane trigonometry, algebra, and analytical geometry. For small areas, precise results may be obtained with plane surveying methods, but the accuracy and precision of such results will decrease as the area surveyed increases in size. For example, the length of an arc 18.5 km long lying in the earth's surface is only 7 mm greater than the subtended chord and, further, the difference between the sum of the angles in a plane triangle and the sum of those in a spherical triangle is only 0.51 second for a triangle at the earth's surface having an area of 100 km^2. It will be appreciated that the curvature of the earth must be taken into consideration only in precise surveys of large areas.

A great number of surveys are of the plane surveying type. Surveys for the location and construction of highways, railroads, canals, and in general, the surveys necessary for the works of human beings are plane surveys, as are the surveys made to establish boundaries, except state and national. However, with the increasing size and sophistication of engineering and other scientific projects, surveyors who restrict their practice to plane surveying are severely limited in the types of surveys in which they can be engaged.

The operation of determining elevation usually is considered a division of plane surveying. Elevations are referred to the geoid. The geoid is theoretical only. It is the natural extension of the mean sea level surface under the landmass. We could illustrate this idea by digging an imaginary trench across the country linking the Atlantic and Pacific oceans. If we allowed the trench to fill with seawater, the surface of the water in the trench would represent the geoid. So for all intents and purposes, the geoid is the same as mean sea level. Mean sea level is the average level of the ocean surface halfway between the highest and lowest levels recorded. We use mean sea level as a datum or, curiously and incorrectly, a datum plane upon which we can reference or describe the heights of features on, above or below the ground.

Imagine a true plane tangent to the surface of mean sea level at a given point. At horizontal distances of 1 km from the point of tangency, the vertical distances (or elevations) of the plane above the surface represented by mean sea level are 7.8 cm. Obviously, curvature of the earth's surface is a factor that cannot be neglected in obtaining even rough values of elevations. The ordinary procedure in determining elevations, such as balancing backsight and foresight distance in differential leveling, automatically takes into account the curvature of the earth and compensates for earth curvature and refraction, and elevations referred to the curved surface of reference are secured without extra effort by the surveyor.

There is close cooperation between geodetic surveying and plane surveying. The geodetic survey adopts the parameters determined by measurements of the earth, and its own results are available to those who measure the earth. The plane surveys, in turn, are generally tied to the control points of the geodetic surveys and serve particularly in the development of national map series and in the formation of real estate cadastres.

Words and Expressions

artificial [ˌɑːtiˈfiʃəl] *adj*. 人造的，假的，非原产地的
analog [ˈænəlɔg] *n*. 类似物，相似体
chart [tʃɑːt] *n*. 图表，海图
dimensional [diˈmenʃənəl] *adj*. 空间的
monument [ˈmɔnjumənt] *n*. 纪念碑
permanent monument 永久标石
monumentation 埋石
fieldwork [ˈfiːldwəːk] *n*. 野外工作，实地调查，野外作业
category [ˈkætigəri] *n*. 种类，类别，[逻]范畴
permanent [ˈpəːmənənt] *adj*. 永久的，持久的
theodolite [θiˈɔdəlait] *n*. [测]经纬仪
prerequisite [ˌpriːˈrekwizit] *n*. 先决条件
spheroid [ˈsfiərɔid] *n*. 球状体，回转椭圆体
allowance [əˈlauəns] *n*. 容许误差，容差，容许量
diameter [daiˈæmitə] *n*. 直径
equator [iˈkweitə] *n*. 赤道，赤道线

latitude [ˈlætitjuːd] *n*.纬度，范围；(用复数)地区
longitude [ˈlɔndʒitjuːd] *n*.经度，经线经度
meridian [məˈridiən] *n*.子午线，正午，顶点，全盛时期 *adj*.子午线的，正午的
prime meridian 本初子午线，本初子午圈线
northing [ˈnɔːθiŋ] *n*. 北距(向北航行的距离)，北进，北航
easting [ˈiːstiŋ] *n*. 东西距，朝东方；东行航程
gravity [ˈgræviti] *n*.重力，地心引力
gravity field 重力场
curvature [ˈkəːvətʃə] *n*. 曲率，弯曲
plumb [plʌm] *n*.铅锤，铅弹 *adj*.垂直的 *vt*.使垂直，探测
plumb line 铅垂线
trigonometry [ˌtrigəˈnɔmitri] *n*.三角法
plane trigonometry 平面三角
algebra [ˈældʒibrə] *n*.代数学
analytical [ˌænəˈlitikəl] *adj*.解析的，分析的
analytical geometry 解析几何
chord [kɔːd] *n*.弦，弦长
triangle [ˈtraiæŋgl] *n*.[数]三角形，三人一组，三角关系
spherical [ˈsferikəl] *adj*.球形的，球的
sophisticate [səˈfistikeit] *vt*. 弄复杂，篡改；使变得世故
sophistication [səˌfistiˈkeiʃən] *n*. 复杂；强词夺理，诡辩
geoid [ˈdʒiːɔid] *n*.[地]大地水准面
trench [trentʃ] *n*.沟渠，堑壕，管沟，电缆沟，战壕
Atlantic Ocean 大西洋
Pacific Ocean 太平洋
tangent [ˈtændʒənt] *adj*. 相切的，切线的 *n*.切线，[数]正切
backsight [ˈbæksait] *n*.后视
foresight [ˈfɔːsait] *n*. 前视；远见，深谋远虑
refraction [riˈfrækʃən] *n*. 折光，折射

Terms Highlights

geodetic surveying 大地测量，大地测量学
plane surveying 平面测量，平面测量学
control survey 控制测量
horizontal survey 水平测量，平面测量
vertical survey 高程测量，垂直测量
topographic survey 地形测量
detail survey 碎部测量

land survey (*property survey*, *boundary survey*, *cadastral survey*)土地测量，地籍测量
route survey 路线测量
pipe survey 管道测量
city survey 城市测量
hydrographic survey 水道测量
marine survey 海洋测量
mine survey 矿山测量
geological survey 地质测量