Karlheinz Güthner [1] and Jürgen Peipe [2]

PC-assisted translation of photogrammetric papers

A PC-based system for machine translation of photogrammetric papers from the English into the German language and vice versa is described. The computer-assisted translating process is not intended to create a perfect interpretation of a text but to produce a rough rendering of the content of a paper. Starting with the original text, a continuous data flow is effected into the translated version by means of hardware (scanner, personal computer, printer) and software (OCR, translation, word processing, DTP). An essential component of the system is a photogrammetric microdictionary which is being established at present. It is based on several sources, including e.g. the ISPRS Multilingual Dictionary.

1. Introduction

In recent years, the majority of papers dealing with photogrammetry and remote sensing have been published in English. Authors using another mother tongue are obliged to translate their reflections into English in order to communicate effectively with their colleagues. Generally speaking, translations from English into any other language and vice versa are indispensable in order to become acquainted with the ideas and activities of photogrammetric scientists and practitioners world-wide. ISPRS, considering the importance and necessity of international contacts and co-operation, promotes the publication of the "Multilingual Dictionary for Photogrammetry and Remote Sensing" (e.g. Lindig, 1988).

Translations are supposed to be created with high skill and accuracy. The often troublesome process may involve considerable expenditure of time and money. Thus, approaches to machine translation are helpful and advisable.

In this paper, LogoS the computer-assisted translation system (Soft-Train, 1991) is described which comprises the following steps: (a) preparing an input file of the original text in the source language; (b) generating an output file of the text translated into the target language; (c) post-editing the target document; (d) updating the dictionaries if necessary; (e) finishing the layout of the translated text.

The GLOBALINK translation program (Globalink, 1990) is the core of the LogoS system. GLOBALINK offers not only an on-line vocabulary, but affords full-scale text analysis according to syntax and grammar before translating into the target language.

Papers written in any technical language necessitate special dictionaries which contain subject-specific terminology concerning an individual area of application (see Sect. 3). The general dictionary of GLOBALINK can be superimposed therefore with additional subject-specific microdictionaries, i.e. words to be translated are first looked for in a microdictionary and after that, if a word is not found, it will be searched for in the general dictionary. This procedure improves substantially the quality of translation (see Sect. 4).

It is an important feature of GLOBALINK that both the general dictionary and the microdictionaries have two sections, a single word database and a semantic unit database. "A semantic unit consists of lexical units of more than one word which have a meaning other than the literal translation of the constituent words" (Globalink, 1990). Semantic units such as phrases, idioms and application-specific terms appropriate to the text are essential to obtain a satisfactory translation (see Sect. 3).

Machine-assisted translation cannot replace the high-skilled human interpreter, but may strengthen his creativity and increase productiv-

[1] Soft-Train GmbH, Martin-Schneller-Straße 9, D-7798 Pfullendorf, Germany

[2] Universität der Bundeswehr München, Institut für Photogrammetrie und Kartographie, Werner-Heisenberg-Weg 39, D-8014 Neubiberg, Germany

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ity. This statement holds true particularly when using the interactive "sentence-by-sentence" mode of GLOBALINK (see Sect. 2). In addition, fully automated translation may be regarded as a useful tool for producing rapid draft translations to simply comprehend the general meaning of a text.

In the following sections, the system design of LogoS and GLOBALINK is outlined. German and English are used as both the source language and the target language. This paper was originally written in German and then translated into English, mostly by means of LogoS. The draft translation was post-edited by the authors.

2. System design

LogoS consists of hardware and software to produce an automated data flow from the original text in the source language into the translated version in the target language (Fig. 1). To control, improve and optimize the result of the process, an interactive mode is provided.

Hardware components of LogoS are scanner, personal computer, and printer. In general, any standard product can be used. To obtain satisfactory productivity, i.e. to create high-quality translation in adequate time, the standard of performance as presented in Fig. 2 is recommended.

Software includes a program for OCR (optical character recognition: OmniPage Professional 3.0), a word processing program (connected to Microsoft WINDOWS 3.x) and the translation program GLOBALINK (Release 2.0) as the kernel.

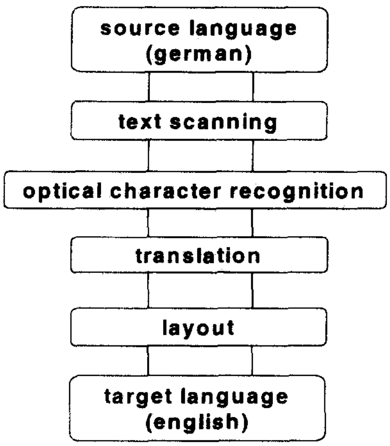

Figure 1. Flow-chart of the LogoS system (translation of a German text into English).

Hardware configuration	
computer	80386 / 80486
ram	min. 4 mb
hard disk	min. 120 mb
monitor	17", vga, colour
scanner	12", 300 dpi
printer	PostScript laser printer
operating system	DOS 5.0, Windows 3.1

Figure 2. Hardware configuration.

The dictionaries are integrated elements of the translation software (see Sect. 3).

A document in the source language may be entered in the personal computer in different ways. The text can be typed in by means of any word processor which is able to create a plain ASCII text file. GLOBALINK needs the input file in this format. Besides, the source document may already exist in ASCII format on a diskette or hard disk.

Papers already printed can be entered automatically. The pages are digitized on a flatbed-scanner with a resolution of not less than 300 dpi. The document, then existing as bitmap, is transformed into ASCII data by means of the OCR software OmniPage. The digitized patterns of all the characters are reduced to typical features and compared to pre-defined patterns by recognition algorithms.

The reliability of detection depends on the quality and size of the scanned characters. More than 99.8% of the characters can be identified properly if their size is equal to or greater than 6 pt and if the original text presents a good quality, i.e. it is type-written or produced by a laser printer or taken from a book. Photocopies of such an original are acceptable as well.

Characters which cannot be recognized by the OCR-software are marked with a special symbol and the corresponding text passages are displayed on the PC monitor for editing. In addition, errors of character detection can be found by the spell checker of OmniPage or of any suitable word processing program. Thus, words containing misinterpreted characters are found and proposed for correction.

The source document saved as an ASCII file serves as input data to the translation program. GLOBALINK offers two modes of operation. The entire text can be translated automatically in batch mode. The result is an output file in ASCII format. The second operating mode allows for interactive processing. In this "manual mode", the text is translated sentence by sentence. Two windows are displayed on the monitor of the personal computer, one with the original version of a sentence and the other with the machine translated version. The user is able to edit both the source and the target text on-line. Words which are not found in the dictionaries are indicated. Thus, the interactive mode may yield an optimized target document because the text is directly visible in both languages and can be modified if necessary.

In contrast to translation tools which transfer a text word by word from the source language into the target language without regarding the syntax, GLOBALINK is a full text translating system. In the first step, the structure of a sentence is analysed and the words are determined according to their grammatical function. The structure of the sentence is then generated in the target language and the words are translated with regard to the grammar. This procedure leads obviously to a considerable improvement of the translation quality.

When using the interactive mode of GLOBALINK, the text can be changed and/or corrected simultaneously with the sentence-by-sentence translating process as mentioned above. If the target document is produced automatically in batch mode, the output file may be edited by means of word processing software. In any case, a draft translation of the source text is provided for subsequent stylistic finishing and any further use within a desktop publishing program.

3. Dictionaries

Dictionaries are essential parts of any translation software. The quality of machine translation is directly related to the number of terms and the extent of information on their grammatical function. The general dictionary of GLOBALINK contains a vocabulary of approximately 65,000 single words and semantic units. "Word" means the vocable itself and its grammatical form (part of speech, gender, inflection etc.). Semantic units (see also the definition given in Sect. 1) are phrases composed of a sequence of single words. They correspond to semantic units in the target language and must not be translated word by word. As a simple example, the term "Dear Sir" transferred into German as "Sehr geehrter Herr" must not be translated as "Very honoured mister".

Subject-specific terms of different technical languages are collected in special microdictionaries, as already mentioned in Sect. 1. If a single word or a semantic unit exists in both the general dictionary and a microdictionary, the subject-specific translation is applied exclusively. Unfortunately, such a microdictionary required for GLOBALINK is not yet available for the subject "Photogrammetry and Remote Sensing", but it is in the process of creation by the authors of this paper. Different sources will be taken into account, e.g. vocabularies, photogrammetric texts, and certainly the "ISPRS Multilingual Dictionary" (Lindig, 1988). The photogrammetric microdictionary is connected to an existing technical microdictionary with special emphasis on electronics and computer science (Soft-Train, 1991).

GLOBALINK provides a dictionary update program for adding and modifying terms and phrases. Single words and semantic units are entered as well in the source as in the target language. The grammatical function of any term is included in coded form. The user of the translation software may edit or extend the dictionaries at any time. It seems that not less than 7,000 terms related to photogrammetry and remote sensing will be required in addition to the general dictionary to achieve a correct translation of photogrammetric papers.

4. Examples

The quality of machine translation can be verified by tests. The following examples were performed in the batch mode of GLOBALINK. The draft translations of Figs. 4, 5 and 7 were produced without any interactive manipulation or post-editing.

First a part of a photogrammetric paper written in English by a German was selected (Peipe, 1991; Fig. 3). The text was properly rendered in the German language by the author himself and then translated into English by means of GLOBALINK. Figure 4 shows the output file, if the general dictionary is used only. Many terms are translated incorrectly, i.e. they do not meet the photogrammetric idiom. Moreover, a lot of German subject-specific vocables remain unchanged in the target document

In recent years, the equipment used for recording architectural objects has changed substantially. This statement holds true as well for the design, size and technical details as for the availability of the imaging systems. Conventional metric cameras such as Wild P31 and P32, Zeiss TMK and SMK (see ATKINSON (1989) for a synopsis of metric cameras) are disappearing from the market for economic reasons. The UMK of Zeiss (Jena) is one of the last genuine metric cameras which is being manufactured up to now. Metric cameras have been effectively used in the recording of buildings and monuments world-wide, but they are too cumbersome and often unflexible for quite a series of photogrammetric tasks.

As a consequence, for many years standard photographic cameras, that means non-metric cameras of 24 x 36 mm and 60 x 60 mm image format have been applied (GEORGOPOULOS 1990). They are small, light-weight, easy to handle and relatively inexpensive, and provide professional photo-technique such as interchangeable lenses, automatic exposure control, motorized film transport and a wide range of system accessories. Besides, a great variety of films with different emulsions is available.

In order to achieve an accuracy of the photogrammetric object restitution comparable to the metric camera approach such a non-metric camera has to be equipped with a réseau plate, that means a glass plate with cross-shaped marks in front of the film surface (WESTER-EBBINGHAUS 1983 and 1989a; see also Fig. 7). This type of camera is called partial metric camera and may be represented by some specially adapted Hasselblad, Leica and Rollei models.

The réseau allows for the correction of systematic image errors caused by the unflatness of the film surface during exposure and any deformation coming from the photoprocessing. The grid crosses are recorded on the film by front-projection at the instant of exposure. The imaged cross positions can be measured and the displacements as against their precisely calibrated counterparts on the réseau plate are used to eliminate the film deformation effects by numerical transformation into the réseau plane. For this transformation, different methods are feasible. Apart from two-dimensional polynomials which apply to the entire image a meshwise interpolation approach is recommendable (KOTOWSKI 1984).

Besides, the réseau establishes an image coordinate system common to all photographs taken by the same camera. The position of the perspective centre in image space and the lens distortion can be calculated in relation to this frame of reference by camera calibration.

Figure 3. Original text.

In the last years the installation has changed for the photograph of architecture objects essentially. This settlement counts both for the Design, the size and the technical details of the copy systems as well as for the availability. Traditional measuring chambers like them Wildly P31 and P32, which Zeiss TMK and SMK (see ATKINSON (1989) for an overview over measuring chambers) disappear for economic reasons of the market. One of the last real measuring chambers is the UMK of Zeiss (Jena), which is produced until today. Measuring chambers are inserted the world over effectively to the photograph of buildings and monuments, but they are too bulky and often unflexibel for a whole series of photogrammetrischen tasks.

Thus become since many years handelsu"bliche photo apparatus, that is to say Not - Messkammern with a picture format by 24 x 36 mm and 60 x 60 mm inserted (GEORGOPOULOS 1990). They are small, easily, to handle simple and relatively cheaply and put professional photo technology at the disposal like exchange objectives, automatic exposure measurement, motorized film transport and a broad assortment of system accessory. Besides is a large selection of filming with different Emulsionen obtainable.

To achieve one of the Messkammer - methodology comparable precision the photogrammetrischen object reconstruction, a such does not have to be supplied - Messkammer with a Réseauplatte, that is to say a glass disk with kreuzfo"rmigen brands before the film plain (WESTER-EBBINGHAUS 1983 and 1989a; see also Fig. 7). This camera type is marked as part - Messkammer and can be represented through some specially adjusted Hasselblad, Leica and Rollei models.

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Besides the Réseau establishes a picture coordinate system, which is common all photos, which were taken in with the same camera. The position of the projection center in the picture room and the Objektivverzeichnung can be calculated in Relation to this cover system through camera calibration.

Figure 4. Translated version: the general dictionary is used only.

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Besides the réseau establishes an image coordinate system, which is common all photographs, which were taken in by the same camera. The position of the perspective centre in the image space and the lens distortion can be calculated in relation to this frame of reference through camera calibration.

Figure 5. Translated version: the photogrammetric microdictionary is used in addition to the general dictionary.

because they are not available in the general dictionary. Consequently, it was impossible to determine the structure of several sentences. The translation failed in these cases. Figure 5 shows the target text if the photogrammetric microdictionary is applied in addition. Now the technical terms are named correctly. The translation still contains some errors but gives a satisfactory draft interpretation of the content of the text.

The second example serves as an effective quality control of the translating process. The text written and published in English by Atkinson (1989) was translated automatically into German using the batch mode of GLOBALINK. 23 terms were taken from the photogrammetric microdictionary. The target document in German was then slightly post-edited and re-translated into English. Figure 6 shows the original and Fig. 7 the final version without post-editing. The result of the twofold translating process is quite sufficient.

In conclusion, it can be stated that draft translations of photogrammetric papers may be produced with adequate quality by means of the LogoS and GLOBALINK system. However, the

The Geodetic Services CRC-1 provides an extreme contrast to the Polaroid equipment. The CRC-1 represents the ultimate in close-range photogrammetric cameras using conventional photographic techniques (Fig. 3-10). It was developed in 1982 (Brown, 1984; Fraser and Brown, 1986) and is a large-format (230 x 230 mm) microprocessor-controlled, roll film camera designed specifically for close-range industrial photogrammetry. It employs interchangeable lenses with angular fields ranging from wide (f = 120 mm) to medium (f = 240 mm) to narrow angle (f = 450 mm). Lenses can be changed in a matter of minutes. Focusing is continuous from infinity to a near field limit of 11 times the focal length (a photographic scale of 1:10). Each lens is provided with a comprehensive calibration specifying distortion caused by decentering distortion and accounting for variation of symmetric radial distortion throughout the focusing range. All operating functions are continuously monitored by an Intel 8051 microprocessor, and status is displayed on a lighted panel. Errors caused by unflatness of the negative are eliminated through vacuum flattening of the film against an ultra-flat platen. Errors caused by film deformation are eliminated by a patented system for projection through the back of the film of a set of 25 evenly distributed réseau marks.

Figure 6. Original text.

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Figure 7. Twice-translated text.

following remarks are to be noticed:

(1) The text in the source language must be formulated correctly according to syntax and grammar; long and complex sentences should be avoided; typing and spelling errors are extremely destructive because the structure of sentences cannot be recognized properly by the program due to incorrect terms.

(2) The use of a photogrammetric microdictionary is indispensable; moreover, it has to be updated continuously.

(3) The interactive translation mode of GLOBALINK is recommended in particular.

(4) Post-editing is necessary in any case to improve syntax and grammar and to stylistic finishing.

In the near future, the photogrammetric microdictionary will be further developed by the authors. A series of additional tests may examine the translation system in detail.

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