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Current machine translation systems developed with GETA's methodology and software tools

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INTRODUCTION: BACKGROUND TO THE METHODS USED

The Groupe d'Etudes pour la Traduction Automatique (GETA) is a research group founded by the late Professor B. Vauquois in 1971, and pursuing the work of the former CETA laboratory (1961-70). GETA's methodology has been discussed extensively elsewhere [5, 6, 8, 20]. It revolves around three main facets: how to automate the translation process, what kind of linguistics to incorporate in the 'lingware', and with which kind of basic, linguistics-independent software. Before we go on to describe specific translation systems, let us review these three facets briefly.

HOW TO AUTOMATE THE TRANSLATION PROCESS?

Research on machine translation (MT) centres on the *automation of the translation process,* rather than on the perfect translation of some particularly difficult test sentences. The real problem to attack is the translation of *documents* in some real setting.

Hence, we envisage MT systems as components of larger systems such as computer aided translation (CAT) systems, themselves possibly included in documentation systems, to take an example.

Translating a document usually involves four phases:

—*acquisition* of the document and terminological preparation.

—*rough translation,* possibly done in parallel by several translators. Following a suggestion by H. Karlgren, we will call the rough translation 'raw' when it is produced with revision in mind, as opposed to 'crude' when no revision is foreseen (online translation of abstracts in a database, for instance).

—*revision*, if any, sometimes done in several passes: for technical documents, technical revision by a (possibly monolingual) specialist in the field is often required.
—*output* of the final document, including figures, charts, etc.

A document may be created in a translation environment (as in the EC), or sent to it in its final form. As soon as some automation is envisaged, machine aids are in current use for putting the document in machine-readable form (text-processing systems, possibly coupled with OCRs).

Strictly speaking, the creation of a document is not a function of the translation process. But, if this creation can be linguistically controlled by some linguistic process, automation of the rough translation becomes a lot easier. The TITUS system (of the Institut Textile de France) illustrates this point.

CAT techniques centre around the total or partial automation of the rough translation process. Two main approaches have been tried. In the first, translation is done by a program, in batch or interactive mode. GETA, TAUM, SFB-100, and METAL all follow the batch line. BYU (ITS), ALPS and WEIDNER have tried the interactive approach. Such systems are generally referred to as machine translation (MT) systems, or as human aided machine translation (HAMT) systems.

The second approach is generally called machine aided human translation (MAHT). Here, emphasis is on the automation of the translator’s office, with specialised text processing systems, fast access to online terminological databanks, spellcheckers, etc.

Within the HAMT approach, two strategies are possible. First, one can try to *define* some subset of a given natural language as a formal language. Then, an analyser is built. If a given unit of translation is ‘legal’, it will be translated. If not, it will be rejected. Hence, the automatic system is a ‘partial system’, because it translates only N% of the input. TAUM-METEO (until August 1985), or the first CETA systems (before 1970) are good examples of this strategy.

The second strategy, followed in all current GETA systems, is to build a ‘total system’, which will always attempt to translate 100% of the input, even if it is partially ill-formed with regard to the implemented linguistic model.

The revision of a document is usually done with the help of text processing systems. But the automation of the revision function itself has not yet been attempted, neither by GETA nor by others. It seems that the level of understanding and of general knowledge required to perform even a ‘linguistic’ revision is higher than the one required for translation. This is even more true in the case of ‘technical’ revision.

Automated systems for the output of the final document are widely used, and are not an object of study for research groups in MT.

LINGWARE

Here are the main points of GETA's linguistic methodology.

- —*Translation units are larger than sentences*, and typically two or three paragraphs long. All other real-size translation systems translate sentence by sentence.
- —The systems rely on the *transfer approach.* Analysis and generation (synthesis) phases are strictly monolingual, while transfer (lexical and structural) is bilingual.
- —*The systems use only linguistic knowledge,* and do not as yet make any use of any 'expertise', that is of an explicit representation of the domain of discourse, separated from the linguistic knowledge. In other words, they behave like compilers of artificial languages, which translate programs without being able to recognise the functions computed by these programs.
- —*Multilevel interface structures* (decorated tree structures), imagined by B. Vauquois in 1974, represent units of translation at various levels of linguistic interpretation, ranging from lexical properties to semantic and logical relations.
- —*Lexical units are* used to represent whole derivational families, thus allowing easy inter-class paraphrasing in generation. To the best of our knowledge, no other group or firm is yet using this organisation of the lexicon.
- —*Heuristics* are used in linguistic programming, as well as declarative/combinatorial techniques.
- —In 1983, B. Vauquois introduced the use of *Structural Correspondence Static Grammars (SCSG)* to specify and document the 'dynamic' grammars written in the various Specialised Languages for Linguistic Programming (SLLPs), transposing methods of software engineering to lingware engineering.

SOFTWARE

- —Linguists and lexicographers use an *interactive and integrated programming environment* hiding all ancillary tasks (like file management), called ARIANE-78.
- —linguistic programming is done in *SLLPs,* all based on production systems and incorporating very high-level data and control structures (decorated trees, recursion, parallelism, non-determinism, heuristic functions), with built-in checks of possible sources of undecidability (infinite loops).
- —the generalised use of *transducers rather than analysers* leads to the possibility of implementing *fail-soft techniques.*

MT SYSTEMS DEVELOPED AS LABORATORY EXPERIMENTS

Types and aims of such systems

MT systems are developed in the laboratory for four main reasons.

1. *To validate the linguistic methodology for multilingual systems* by attacking various languages, preferably pertaining to different groups or families. This is why we started long ago with Russian-French, and are now beginning a study on French-Chinese.
2. *For training and testing purposes* as is or was the case for Portuguese-English (POR-ENG), French-English and English-French 'for the example' (BEX-FEX and FEX-BEX), English to Chinese and Japanese (INI – HAN, JAP), or Chinese into five other languages (HAN-ENG, FRA, GER, RUS, JAP).
3. *To prepare further large-scale development* by developing methods and tools for lingware engineering, and carrying out genuine experiments. This has been the case for Russian-French since 1982.
4. *To support linguistic research* on some language(s) or pair(s) of languages (e.g. German-French, English-Arabic).

There now follow further details on the two most developed systems.

Russian - French: a real-size operational prototype

This system is being constantly developed, improved, and used on real texts, in the framework of an operational translation unit (since April 1982).

The various dictionaries contain some 7,500 lexical units in Russian and 5,000 in French, which amounts to roughly 30,000 terms in normal dictionaries (remember that a lexical unit is a family of 'lemmas', which may correspond to simple or complex terms), because of the richness of the derivational systems used for the two languages.

The grammars cover a possibly too wide range of typologies, ranging from titles and technical abstracts to scientific articles. Technical abstracts are by far the most difficult, due to the poor quality of writing, the length of sentences, the abundance of apocopes (e.g. the abund. of apoc.'), and the presence of figures and mathematical formulae.

As the texts are not presented on magnetic support, it is necessary to type or read them in. In 18 months (April 1984-October 1986), around 200,000 running words, or 1.5 million characters, have been input into the textual database, half of them using an OCR (in co-operation with the Paris-based CERTAL research group).

In one month (September 1986), around 835 abstracts and texts, or

97,000 running words, have been translated or retranslated on a shared minicomputer (IBM 4331-2 with 4 megabytes under VM/CMS), to present a set of coherent results in the final report of a contract with the Ministry of Defence.

This system is also used as support for contrastive studies by its main author, N. Nedobejkine.

Some examples of machine translations with manual on-screen revisions are given in the annex. In the first, long example, some words appear between brackets, like (<"m_AMX-30>). This is because their lexical unit was not in the Russian dictionaries. But, in most cases, the morphological subgrammar for unknown words has correctly analysed them. Here, the special prefix "m introduces a trademark, hence, an inanimate proper noun.

The second, shorter example, exemplifies the improvement obtained by modifying the lingware. Here, three or four dictionary items have been corrected in transfer and generation. For example, ‘introduction dans’ is replaced in the second translation by ‘introduction à’, and ‘golografia’, having been indexed, is no longer broken down into ‘golo-’ (nude) and ‘grafia’ (graphy), and is correctly translated as ‘holography’.

The virtual central processing unit (CPU) time used for translating one word is about 1.4 Mipw (million operations per word). In terms of elapsed time on a shared 4331-2 (4 Mb, 0.4 Mips), it amounts to 20 minutes per page of 250 words. On-screen revision of the long example (TANK2) took less than 15 minutes, including terminological discussion, and using the standard ARIANE-78 REVISION subenvironment (XEDIT in two or three windows configuration, plus some useful macros associated with certain keys).

German-French: a feasibility study supporting linguistic research

This system uses the same generation of French as the former one. The German side (analysis and transfer) is still a prototype, covering a restricted typology and based on a small lexicon (around 2,000 lexical units, or 4,000 terms for German).

One particular feature is its development by two independent researchers, one in Paris (G.Stahl) and the other in Grenoble (J.P. Guilbaud). The first author developed the structural analysis, and the second the morphological analysis and the transfer.

However, no large-scale development is planned for the moment. Guilbaud is now using this system as support for a study on the possibility of integrating some results of the linguistic research carried out by J.M. Zemb (Collège de France, Paris), mainly on contrastive French-German grammar, but also on the fundamental notions underlying grammatical descriptions.

MT SYSTEMS DEVELOPED IN ACADEMIC CO-OPERATION

Aims of such systems

B. Vauquois has always sought international co-operation, in order to compare different points of view on natural language processing, and to try them experimentally, MT being perhaps the best benchmark.

In the 1960s, permanent contacts were established with scholars from the United States, the USSR, Japan, Czechoslovakia, and almost all West European countries. Long visits by Czech and Japanese colleagues reinforced these links, but no common systems, or even mock-ups, were built.

In the 1970s, GETA developed a truly language- and theory-independent software environment for building multilingual MT systems, ARIANE-78. This tool (or its preceding versions) supported the development of a series of experiments, all done in co-operation with foreign colleagues: several analyses of French (J. Weissenborn and E. Stegentritt, Saarbrücken), an analysis of Portuguese with a mock-up transfer and generation into English (P. Daun Fraga, Campinas), a structural analysis of Japanese (R. Shimamori), and prototypes from or into Chinese (Feng Zhi Wei, Yang Ping, Beijing).

From 1979 onwards, a long-term co-operation project was started with Malaysia and Thailand, producing two prototypes sharing the same analysis (English-Malay and English-Thai).

English-Malay

This project started in 1979, after a visit by Professor Vauquois to Malaysia, at the initiative of Professor Tan Wang Seng (Universiti Sains Malaysia (USM), Penang). The outline of the project was defined and some common understanding on the methodology was reached during a month’s visit by Professor Tong Loong Cheong and Dr Chang May See. The ARIANE-78 system was installed at USM.

In 1980, B. Vauquois, P. Daun Fraga and Ch. Boitet spent two months at USM. Starting only from previous desk research (specifications), B. Vauquois, P. Daun Fraga and our two Malaysian colleagues produced a working English-Malay prototype in six to seven weeks, while the author was busy producing an English version of ARIANE-78. At the end of August, an international seminar convened at USM, and the prototype was used extensively for demonstrations and experiments.

Since then, the group at USM has grown and become permanent. At the end of 1985, the English-Malay system had reached the stage of a laboratory prototype. It was systematically evaluated, with a resulting acceptability rate of 76% [21]. The stage of operational prototype should be reached at the end of 1988, the system aiming mostly at translating computer related technical material.

English-Thai

Initiated during the 1980 USM seminar, this co-operation started effectively in 1981. Several Thai universities participate in this effort (Ramkhamhaeng, Chulalongkorn, Prince of Songklah, etc.). The stage of laboratory prototype should be attained at the end of 1987.

Of course, the peculiarities of the Thai writing system have been a challenge. But the computer scientists from Chulalongkorn have connected the ARIANE-78 system to special I/O (input/output) devices, so that translations can be produced in Thai characters.

It may be interesting to note some unexpected turns of international co-operation: the scientific leader of the group, Professor N. Kanchana-wan, as well as his chief scientific sponsor at Ramkhamhaeng University, Professor U. Warotamasikkadit, gained their Ph.D. at Austin, Texas, the origin of the well-known METAL system.

MT SYSTEMS DEVELOPED FOR INDUSTRIAL PURPOSES

The French MAT-NP (National Project)

The French Machine (Aided) Translation National Project, or MAT-NP for short, started in November 1983, and is now nearing the end of its third phase, scheduled for February 1987. Financing of the project is 50% public and 50% private. Public financing and control is handled by ADI (Agence De l'Informatique), while the private firm SG2 and its subcontractors (including the SONOVISION and B'VITAL firms) have invested the rest and are building the system. A first official presentation of CALLIOPE-AERO was made at EXPOLANGUES (Paris) in February 1986.

For the first development, it was decided to build a French-English system tailored to aviation manuals of the kind produced by SONO-VISION, which are in machine-readable form, and for which the appropriate terminology exists in both languages.

After EXPOLANGUES, it was decided to begin the development of CALLIOPE-INFO (English to French for computer-related material), which was until then merely one option of the project. The development of the corresponding analyser and generator is about mid-point, and transfer has begun, as well as indexing. The first translations should be available at the beginning of 1987.

The core of the architecture of the lingware and the software comes from previous work done at GETA, but new tools and techniques have been added. Let us present them briefly, before presenting CALLIOPE-AERO and CALLIOPE-INFO.

Connection of a translator workstation

SG2 selected QUESTAR-400 for implementing the translator workstation. It is a minicomputer from Convergent Technology, which offers an ergonomic full-page screen. Several terminals (typically five or six) may be connected to the main processor, which in turn may work in stand-alone mode or connected with an IBM host.

1. In stand-alone mode, it is possible to:
   - prepare a document, using the standard text-processing system, which is of quite good quality.
   - revise the rough machine translation, using a bilingual editor backed up by a dictionary facility. The source text and its translation appear in two vertical windows, both located above the horizontal dictionary window.

     It is also possible to translate manually, and to revise manual translations, if no MT system is available or adequate.
   - convert documents from the QUESTAR-400 format into the ARIANE format. For this, a table-driven transcriptor program has been developed in the local Pascal dialect.
2. In connected mode, it is possible to:
   - just use the QUESTAR-400 as a 3278 terminal.
   - send texts to an IBM computer for translation.
   - receive the machine translations.
   - access the lexical database and generate new versions of the ARIANE dictionaries.
   - generate new versions of the translation modules.

Use of SCSGs for static specification of dynamic grammars

B. Vauquois and S. Chappuy developed a formal model called ‘static grammars’ [10,19] before the start of the MAT-NP.

A structural correspondence static grammar (SCSG) describes the correspondence between the strings of a natural language and the corresponding interface structures. Such a description is neutral with respect to analysis and generation, and does not express any particular strategy for computing the correspondence.

During the first phase of the MAT-NP, from November 1983 until November 1984, only SCSGs of French and English have been developed, and no procedural grammars. Special care has been taken to describe a reasonable core grammar and to study in detail the particularities of the typology under consideration. Like any sublanguage, it offers grammatical constructions which would be judged ungrammatical in other contexts.

These SCSGs must be used as reference and documentation while writing the very large dynamic grammars.

Construction of a lexical database and generation of MT dictionaries

The task of building the dictionaries of a large-scale MT system is ultimately by far the costliest. The technique used at GETA prior to the MAT-NP project consisted in indexing directly into the various ARIANE-78 dictionaries, using a set of 'indexing manuals', written in ATLAS (another specialised language), one for each type of dictionary component (morphological and syntaxo-semantic formats, condition and assignment procedures, lexical units, etc.).

Some problems were foreseen if this technique were to be used for industrial development:

— all codes (names of formats and procedures) should be defined beforehand.
— it was almost impossible to avoid asking questions in terms of the underlying linguistic model, whereas indexers were not expected to have or acquire this type of training, especially the terminologists.
— the same information about a term would be asked twice, once for analysis and once for generation, in case the language under consideration was to be used as source and target (which actually is happening now).

Hence, SG2 has developed a lexical database, comprising a base for each language and a base for each transfer pair. The information attached to the terms is expressed in terms of 'static' properties, which means that it is the same for analysis as for generation. All MT dictionaries are now generated from the database. In the process, ARIANE-78 'codes' are created dynamically.

A division is made between general and terminological terms, for which different 'indexing forms' have been prepared. Terminology is simpler. The questions asked to the indexers still require some linguistic training, but less than with the previous method.

Due to the non-availability of any adequate database management system (DBMS) on the SG2 site, the database has been directly implemented in VSAM (an IBM disk access system), and the associated utility programs in a mixture of COBOL and EXEC. Implementation in a DBMS should follow.

CALLIOPE-AERO (French - English)

The size of grammars and dictionaries is obviously heavily dependent on the application considered. In the case of CALLIOPE-AERO, the typology of the manuals includes almost all normal syntactic constructions, with the exception of interrogative clauses, relative clauses introduced by 'dont' and imperative forms of verbs (replaced by the infinitive form), and a lot of special phenomena.

As far as the lexicon is concerned, a preliminary study of the corpus had led to the estimate that 6,000 general terms and 15,000 terminological terms would be necessary for the system to be usable. The first part is almost complete, while the second may just be complete at the end of the project.

The dictionaries now comprise around 8,000 lexical units in the running system (more in the lexical database), or about 12,000 terms, in both languages. Counting the source lines (written in ATEF for morphological analysis, TRANSF for lexical transfer and SYGMOR for morphological generation), we arrive at a total of about 55,000 lines.

As far as the grammars are concerned, there are about 175 rules for morphological analysis (AM), 600 for structural analysis (AS), 90 for structural transfer (TS), 200 for syntactic generation (GS), and 20 for morphological generation (GM). In terms of source lines, we find, for the grammatical part of the same phases, a total of around 4,500 (AM), 18,000 (AS), 2,300 (TS), 5,600 (GS) and 470 (GM).

If we compare this with the size of a compiler for some programming language, written in metalanguages such as LEX and YACC, we see that the lingware engineering effort required to create and maintain such an MT system exceeds by far what is required for a compiler. This is made even worse by the fact that natural language is not fixed by decree, but changes, and is not defined by our grammars, but only approximated. Contrary to the case of a compiler, the grammars and dictionaries of an MT system must be easily modifiable by linguists and not by computer scientists. Hence, modularity in the SLLPs and user-friendliness of the programming environment are essential.

CALLIOPE-INFO (English-French)

This system is currently being built. It aims at translating computer manuals. The SCSGs of French and English are of course re-used and enriched for two reasons:

— the typology changes, hence, more grammatical phenomena must be accounted for;
— ambiguity ‘boards’ (‘planches’, or two-dimensional representations of rules in an SCSG) are being constructed for English, as they have been for French. They are useful for analysis, where they help design the disambiguation (dynamic) rules.

The dynamic grammars for the analysis of English and for the generation of French are derived from those developed by GETA, in-house or in co-operation (see above).

Indexing of the terminology is done by SONOVISION, as for CALLIOPE-AERO. The aim is to attain 6,000 specialised terms for the first version (around mid-1987).

CONCLUSION

Cost-effective second generation MAT systems are beginning to appear at several locations. It is our firm belief that, due to the techniques employed, MT systems based on GETA's linguistic methodology and software tools can be developed and improved far more easily than previous systems.

During the development of an MT system, it seems important to keep in mind the destination of its translations ('raw' or 'crude', in H. Karlgren's words), because this strongly influences its design.

Building MT systems is also a very good support for international co-operation and for linguistic research on what is really 'computable' in the formalised part of linguistics and (perhaps) translation theory.

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ANNEX: EXAMPLES OF TRANSLATIONS

Remember that Russian-French is designed to produce ‘crude’ translations, while French-English aims at producing ‘raw’ translations, which are necessarily revised to obtain a very high quality.

Two examples are given for Russian-French, as they are produced by the ARIANE-78 system, on the IBM mainframe. For CALLIOPE-AERO, we also give two examples, as they appear on the screen of the connected QUESTAR-400.

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1. Russian – French

1.1. A long example, with source text, machine translation and human revision

LANGUES DE TRAITEMENT: RUB - FRB

----- (TRADUCTION DU 24 SEPTEMBRE 1986   9H 31MN 26S) -----
VERSIONS : (A : 21/07/86 - T : 21/07/86 - G : 21/07/86)

6/11/86 ----- (REVISION DU 6 NOVEMBRE 1986   10H 58MN 54S) -----

-- TEXTE SOURCE --

Na tanke ustanovlen 12-cilindrovyij mnogotoplivnyij dizelq s turbonadduvom i zhidkostnyim oxlazhdeniem "m_HS-110. Mexanikheskaya transmissiya "m_5SD_200D vklyukhaet v sebya pyatistupenkhatuyu korobku peredakh, avtomatikheskoe centrobezhnoe sceplenie s yelektroprivodom, mexanizm povorota, tormoz s gidroprivodom i planetarnyie bortovyie peredakhi. Podveska opornyix katkov torsionnaya. Na pervom i pyatom katkax ustanovlenyi gidroamortizatoryi . Tank oborudovan sistemoj zathityi ot oruzhiya massovogo porazheniya , avtomatikheskoj sistemoj pozharotusheniya. OPVT pozvolyaet tanku preodolevatq po dnu vodnyie pregradyi glubinoj do 4 m .

Na baze tanka "m_AMX-30 sozdanyi mostoukladkhik "m_AMX-30PP , remontno-yevakuacionnaya mashina "m_AMX-30D, samoxodnaya zenitnaya ustanovka "m_AMX-30SA, samoxodnyij zenitnyij raketnyij kompleks "m_AMX-30R, samoxodnaya puskovaya ustanovka raketyi "Pluton" i samoxodnoe orudie "m_AMX-30GT.

-- TEXTE TRADUIT --

Sur le char on a installé un diesel polycarburant à 12 cylindres avec la suralimentation par turbosoufflante et le refroidissement par liquide <"m_HS-110>. La transmission mécanique <"m_5SD_200D> comprend la boîte à cinq étages de vitesses, embrayage centrifuge automatique avec la commande électrique, mécanisme de direction, le frein avec la commande hydraulique et les engrenages de bord planétaires. La suspension de galets porteurs est à barre de torsion. Sur les galets premier et les galets cinq on a installé les amortisseurs hydrauliques. Le char est équipé du système de protection contre l'arme de destruction massive, le système automatique de lutte contre incendie. Le schnorchel permet au char de franchir sur le fond les obstacles fluviaux de la profondeur jusqu'à 4 m.

Sur la base du char <"m_AMX-30> on a créé pontonnier <"m_AMX-30PP>, véhicule de dépannage <"m_AMX-30D>, canon antiaérien automobile <"m_AMX-30SA>, un ensemble de fusée antiaérien automobile <"m_AMX-30R>,

-- TEXTE REVISE --

Sur le char, on a installé un diesel polycarburant à 12 cylindres avec suralimentation par turbosoufflante et refroidissement par liquide HS-110. La transmission mécanique 5SD 200D comprend une boîte de vitesses à cinq étages, un embrayage centrifuge automatique avec commande électrique, un mécanisme de direction, un frein avec commande hydraulique et des engrenages de bord planétaires.

La suspension de galets porteurs est à barre de torsion. Sur les premier et cinquième galets, on a installé des amortisseurs hydrauliques. Le char est équipé d'un système de protection contre l'arme de destruction massive, et d'un système automatique de lutte contre l'incendie. Le schnorchel permet au char de franchir sur le fond les obstacles fluviaux de profondeur jusqu'à 4 m.

Sur la base du char AMX-30, on a créé le pontonnier AMX-30PP, le véhicule de dépannage AMX-30D, le canon antiaérien automobile AMX-30SA, l'ensemble de fusée antiaérien rampe de lancement automobile de la fusée <"Pluton"> et canon automobile <"m_AMX-30GT>.

. Dès 1982 dans l'armée a commencé à entrer modèle modernisé du char qui a reçu le nom <"m_AMX-30B2>. Contrairement à son prédécesseur il est équipé au lieu de la mitrailleuse de 12,7 millimètres du canon mitrailleur de 20 millimètres qui sur l'angle d'élévation aussi a une transmission indépendante. Le char <"m_AMX-30B2> est équipé du système moderne? actuell (Genre?)? de commande du feu <"m_APX-M581>. De sa composition font partie les viseurs télémètre à laser, un ordinateur balistique, un stabilisateur électrohydraulique de l'armement, les instruments infrarouges d'une vision nocturne. Un nouvel obus sous-calibré perforant dont la force de pénétration sur la distance de 2000 m constitue près 350 mm selon les normes est incorporé? branché? dans la dotation en munitions du canon. La mobilité du char modernisé est améliorée grâce à l'installation de la transmission hydraulique et mécanique <"m_ENC-200>.
les travaux selon le perfectionnement ultérieur du char <"m_AMX-30> on a créé un char de base <"m_AMX-32>. Il est équipé d'un canon à âme lisse de 120 millimètres. il a une stabilisation indépendante champs de la vue de la lunette panoramique du chef champs les instruments plus parfaits? perfectionnés (Genre?)? d'une vision nocturne. En outre grâce à l'utilisation du blindage multicouches de la partie avant de la carcasse et de la tour ainsi que des carènes considérablement on a augmenté le niveau de protection.

automobile AMX-30R, la rampe de lancement automobile de fusée "Pluton" et le canon automobile AMX-30GT.

Dès 1982, l'armée a commencé à être dotée d'un modèle modernisé du char qui a reçu le nom AMX-30B2. Contrairement à son prédécesseur, il est équipé, au lieu de la mitrailleuse de 12,7 millimètres, du canon mitrailleur de 20 millimètres, qui a aussi une transmission indépendante selon l'angle d'élévation. Le char AMX-30B2 est équipé du système moderne de commande de feu APX-M581. De sa composition font partie des viseurs télémètre à laser, un ordinateur balistique, uh stabilisateur électrohydraulique d'armement, des instruments infrarouges de vision nocturne. Un nouvel obus sous-calibré perforant dont la force de pénétration à une distance de 2000 m constitue près 350 mm selon la normale est incorporé à la dotation en munitions du canon. La mobilité du char modernisé est améliorée grâce à l'installation de la transmission hydraulique et mécanique
Pendant ENC-200.

Pendant les travaux sur le perfectionnement ultérieur du char AMX-30, on a créé le char de base AMX-32. Il est équipé d'un canon à âme lisse de 120 millimètres, il a une stabilisation indépendante du champ de vision de la lunette panoramique du chef, des instruments plus perfectionnés de vision nocturne. En outre, grâce à l'utilisation du blindage multicouches de la partie avant de la carcasse et de la tour ainsi que des carènes, on a considérablement augmenté le niveau de protection.

1.2. Improving the lingware: a short example

1.2.1. Source text and translation before correcting the dictionaries

LANGUES DE TRAITEMENT: RUB - FRB

----- (TRADUCTION DU 6 NOVEMBRE 1986 8H 40MN 41S) -----
VERSIONS : (A : 21/07/86 - T : 21/07/86 - G : 21/07/86)

-- TEXTE SOURCE --

Cifrovaya obrabotka signalov v optike i golografii. Vvedenie v cifrovuyu optiku.

Izlagayutsya osnovyi nauknnogo napravleniya, izukhayuthego ispolqzovanie cifrovyix processorov v optikheskix i golografikheskix sistemax . Rassmatrivayutsya voprosyi optimalqnogo cifrovogo predstavleniya i modelirovaniya optikheskix signalov i ix preobrazovanij, yeffektivnyie vyikhislitelqnyie algoritmyi i adaptivnyie metodyi obrabotki izobrazhenij, gologramm i interferogramm, sinteza gologramm i yelementov optikheskix sistem.

Dlya naukhnyix rabotnikov, specializiruyuthixsya v oblasti informatiki , v khastnosti zanimayuthixsya obrabotkoj izobrazhenij, optikoj , golografiej i cifrovoj obrabotkoj signalov.

-- TEXTE TRADUIT --

Traitement numéral des signaux dans l'optique et la graphie nue. Introduction dans une optique numérale.

On expose les bases de la direction scientifique qui étudie l'utilisation de processeurs numéraux dans des systèmes optiques et nu (Genre-Nombre?) graphiques. On examine les problèmes de la représentation numérale optimale et du modelage de signaux optiques et de leurs transformations, algorithmes de calculateur efficaces et méthodes adaptables du traitement des représentations, des grammes nus et des interférogrammes, de la synthèse des grammes nus et des éléments de systèmes optiques.

Pour les chercheurs spécialisés dans le domaine de l'informatique, en particulier les représentations qui s'occupent au traitement, optique, graphie nue et le traitement numéral des signaux.

1.2.2. Translation after correcting the dictionaries and revision

LANGUES DE TRAITEMENT: RUB - FRB

----- (TRADUCTION DU 6 NOVEMBRE 1986 14H 27MN 22S) -----
VERSIONS : (A : 9/10/86 - T : 6/11/86 - G : 9/10/86).

6/11/86 ----- (REVISION DU 6 NOVEMBRE 1986 14H 29MN 54S) -----

-- TEXTE TRADUIT --	-- TEXTE REVISÉ --
Traitement numérique des signaux dans l'optique et l'holographie. Introduction à une optique numérique.	Traitement numérique des signaux en optique et en holographie. Introduction à l'optique numérique.
On expose les bases des axes de recharche scientifiques qui étudie l'utilisation de processeurs numériques dans des systèmes optiques et holographiques. On examine les problèmes de la représentation numérique optimale et de la modélisation de signaux optiques et de leurs transformations, les algorithmes de calculateur efficaces et des méthodes adaptables du traitement des représentations, des hologrammes et des interférogrammes, de la synthèse des hologrammes et des éléments de systèmes optiques.	On expose les bases des axes scientifiques de recherche pour l'étude de l'utilisation de processeurs numériques dans des systèmes optiques et holographiques. On examine les problèmes de la représentation numérique optimale et de la modélisation des signaux optiques et de leurs transformations, les algorithmes de calcul efficaces et des méthodes adaptatives du traitement des représentations, des hologrammes et des interférogrammes, de la synthèse des hologrammes et des éléments des systèmes optiques.
Pour les chercheurs spécialisés dans le domaine de l'informatique, en particulier les représentations qui s'occupent au traitement, l'optique, l'holographie et un traitement numérique des signaux.	Destiné aux chercheurs spécialisés dans le domaine de l'informatique, en particulier à ceux qui s'occupent du traitement des représentations, de l'optique, de l'holographie et du traitement numérique des signaux.

2. French – English (CALLIOPE-AERO)

French	English
- Enduire légèrement les joints et les pièces de liquide d'utilisation (AIR 3520b). - Placer des joints neufs dans leur gorge en utilisant l'outil de pose de joint et en prenant toutes les précautions nécessaires à leur montage correct.	- Slightly coat the joints and the parts with operating fluid (AIR 3520b). - Put new joints into their grooves by using the joint installation tool and by taking all the precautions necessary for their correct assembly.
- Poser une nouvelle rondelle frein (2) sur le corps (6). - Placer la valve (4) et le ressort (3), puis visser l'embout (1). couple de serrage: 4 mdan. - Freiner l'ensemble à l'aide de l'outil de freinage, par déformation de la rondelle frein dans les encoches prévues à cet effet.	- Put [AMBIGU: install] a new stop washer (2) onto body (6). - Position valve (4) and spring (3), then screw nozzle (1). torque load: 4 (??). - Brake the assembly using the braking tool, by distortion of the stop washer in the provided notches.
- Vérifier l'étanchéité du raccord sous une pression de 50 bars pendant deux minutes (voir paragraphe 22.2).	- Check the leaktightness of the coupling under a pressure of 50 bars for two minutes (see paragraph 22.2).
24 - Réparations .	24- repairs.
Intervenir seulement sur le remplacement des joints. Le remplacement du joint (7) s'effectue sans démonter le raccord; pour cette opération, procéder comme suit:	Only intervene in the replacement of the joints. the replacement of joint (7) is carried out without dismantling the coupling; for this operation, proceed as follows:

- agir sur la valve pour la faire reculer, - sortir le joint défectueux en employant un outil de dépose de joint (fil d'inox adapté à ce besoin) et rebuter le joint défectueux,	- act on the valve to make it move back, - extract [AMBIGU: bring out] the faulty joint by using a joint removal tool (wire of stainless steel adapted to this need) and discard the faulty joint,
- enduire légèrement le joint neuf de liquide d'utilisation (AIR 3520b) et le remettre soigneusement dans sa gorge, - le remplacement du joint (5) nécessite le démontage du raccord auto-obturable (voir paragraphe 22).	- slightly coat the new joint with operating fluid (AIR 3520b) and carefully put it again into its groove, - the replacement of joint (5) requires dismantling of the self-sealing coupling (see paragraph 22).

GRAISSAGE. Consignes généralités. Généralités. N'utiliser que des lubrifiants contenus dans leur emballage d'origine et portant la spécification, la désignation et le grade sur la boîte.	GREASING. General instructions. general. use only lubricants contained in their origin wrapping and carr the specification, the designation and the grade on the box.
Nettoyer et sécher les pompes avant leur remplissage. Le remplissage des pompes s'effectue dans un local fermé, très propre, à l'abri de toute possibilité	Clean and dry the pumps before their filling. the Pump filling is carried out in a, very clean closed room [AMBIGU: premises], away from any

d'introduction de poussière dans la graisse.	introduction possibility [AMBIGU: opportunity] of dust into grease.
Faire pénétrer la graisse en force dans les graisseurs jusqu'à ce que la vieille graisse soit éjectée. (sauf indication contraire) .	Make the grease penetrate by force into the lubricators until the old grease is ejected. (unless otherwise stated).
NOTA : lorsque cela est possible, mettre en mouvement les pièces mobiles afin d'assurer un graissage parfait.	NOTE: when that is possible, activate the mobile parts so as to carry out a perfect greasing.
Essuyer la graisse en excédent pour éviter les accumulations des saletés.	Wipe the excess grease to avoid accumulating the dirt.
Refaire éventuellement l'identification du graisseur par peinture rouge.	If necessary repeat the identification of the lubricator red paint.