

Interactive Translation : a new approach

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Abstract

A new approach for Interactive Machine Translation where the author interacts during the creation or the modification of the document is proposed. The explanation of an ambiguity or an error for the purposes of correction does not use any concepts of the underlying linguistic theory : it is a reformulation of the erroneous or ambiguous sentence. The interaction is limited to the analysis step of the translation process.

This paper presents a new interactive disambiguation scheme based on the paraphrasing of a parser's multiple output. Some examples of paraphrasing ambiguous sentences are presented.

Key-words

Machine Translation, Interactive Translation, Intelligent Word Processor.

A. THE PROBLEM

Goals

The main goal here is to resolve *correctly* ambiguities arising in natural language analysis *in every case*. To date, this cannot be accomplished by any existing automatic MT system. The problem remains choosing a sentence structure that most accurately reflects the author's intended message and it therefore remains an unsolved and yet important problem.

Classical machine translation systems use heuristics based on statistical regularities in the use of language. Interactive systems ask questions directed at a specialist of the system (like ITS of BYU [Melby & alii 80]) and/or a specialist of the domain (like the TITUS system of Institut Textile de France [Ducrot 82]). There, the interaction is done purely at the syntactic level, as a syntax directed editor for a programming language is used by a specialist of both the system and the language¹.

Models or projects using extralinguistic knowledge will not be able to solve ambiguities in every case: a document is generally supposed to provide some piece of *new* information that may not be coded in the knowledge base.

The use of learning procedures is at present not effective.

None of these approaches can resolve ambiguities correctly in every case. The problem is basically a matter of *interpretation*: only the author of the document himself can tell what he intended to say. Nevertheless, he is not supposed to have any knowledge of the target language and therefore, he should not be involved during the transfer phase².

In the case of interaction with the author, two problems arise:

1. The author is supposed to write his document and not to solve weird linguistic problems.
2. In all interactive systems, the system asks a specialist questions based on knowledge of the underlying linguistic theory. For interacting with the author, this approach is to be rejected: see examples of interaction with ITS [Melby & alii 80] or even Tomita's system [Tomita 84].

A proposal

To solve these problems, we propose :

- to integrate the interactive system as one function of a word processor, the interaction being initiated by the author;
- to explain an ambiguity presenting a set of *paraphrases* generated from the set of parse trees of the ambiguous sentence;
- to explain an error (of spelling and of grammar) by presenting a "reasonable" correction and a comment of the error. This point will not be treated in this paper. See for example [Jensen & Heidorn 83, Zajac 86b].

Discussion

The integration in a word processor allows the use of a "controlled language" where checking and correction is done during the creation or modification of a document. This can be viewed as an extension of the capabilities of a simple spellchecker, in the form a toolbox of linguistic aids for the author, checking the spelling, the terminology, the grammar and the style. For the translation of technical material, the use of a normative grammar, imposing precise limitations on terminology and syntax, will entail more clarity and concision in expression, as argued by [Elliston 79] and [Ruffino 82], and will offer a convenient tool for normalizing a documentation.

In the cases where a correct interpretation uses domain knowledge interactively, it will be possible to make a clear cut between the pure linguistic knowledge, to be coded in the analyser, and the extralinguistic knowledge (semantics of the domain). As a matter of fact, it is not always justified to integrate in the grammar specific semantic categories, as in the METEO system for example. This separation will allow us to enlarge the domain of applicability of a machine translation system, that could be, for example, extended to a personal translation system [Tomita 84], and this could be interesting when no translation service is available or if the quantity of translation does not justify using the services of a translator [Kay 82].

B. THE PROPOSAL

The linguistic framework

The linguistic treatment of ambiguities is based on the structure of a linguistic descriptor (labeled and attributed tree) defined in SCSL [Zajac 86a]. Let us recall briefly the multilevel linguistic theory of

GETA [Vauquois 78]. There are four main levels of linguistic interpretation:

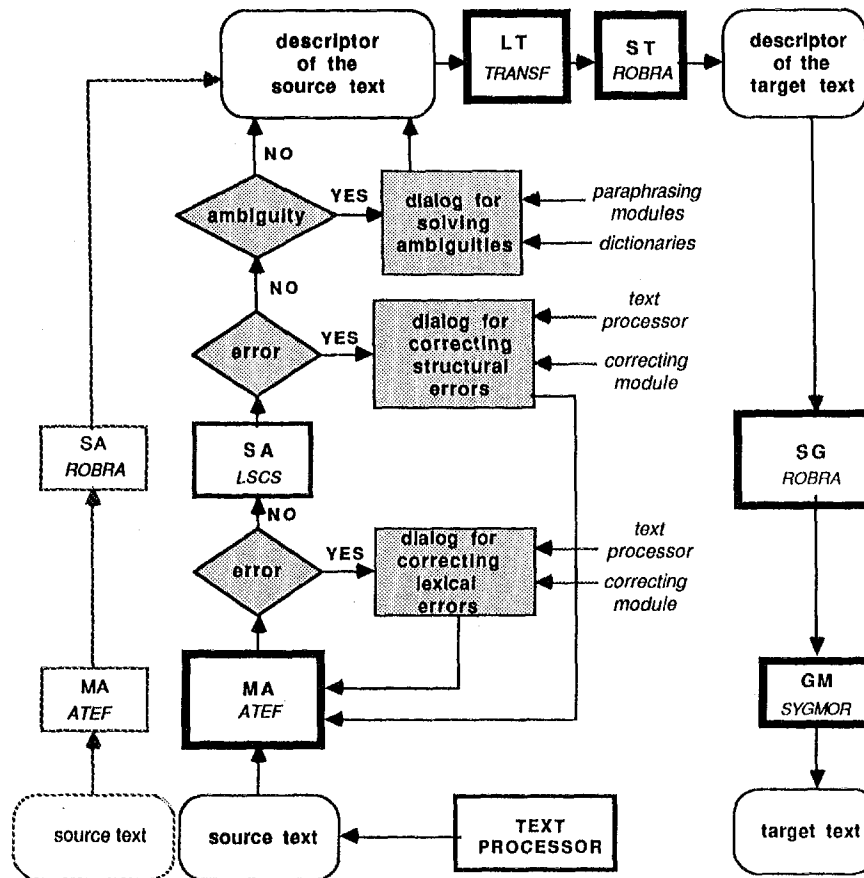
1. *categories* : morphosyntactic categories (gender, number, class of verb,...), semantic categories (abstract, concrete,...), actualisation categories (perfective, imperfective,...), syntactic categories (noun, verb, valencies,...) and syntactic classes (sentence, verb phrase,...).
2. *syntactic functions* : subject, object1, object2, attribute of the subject, attribute of the object, complement of noun or adjective, determiner, circumstantial complement,...
3. *logical relations* : predicate-argument relations.
4. *semantic relations* : causality, consequence, qualifier, qualified,...

The geometry of the tree corresponds to a phrase structure : the labels of inner nodes are syntactic classes, the labels of leaves are lexical units. Additional information is coded in the attributes of each node.

The morphological, syntactic and semantic categories are computed by a morphological analyser written in ATEF. The output of the morphological analyser will be the input of a structural analyser producing multiple outputs in ambiguous cases.

Architecture of the interactive translation system

A classical machine translation process in the ARIANE system [Boitet & alii 82, 85] uses a morphological analysis phase (MA) and an automatic structural analysis phase (SA, on the left of the figure). This phase is replaced with an interactive phase (in the middle). Disambiguation and correction dialogues make calls to paraphrasing and correcting modules. The remainder of the process uses classical automatic transfer steps (LT and ST) and generation steps (SG and MG). On the figure, the existing modules are in bold outline, modules where there exists only a model are in normal outline, specified modules are shaded grey).



Strategy for interactive disambiguation

The approach we propose is not to produce explanations using linguistic concepts of the linguistic model (as it has been done up to now, see [Melby & alii 80, Tomita 84]), but to produce *paraphrases* that make explicit the ambiguous relations.

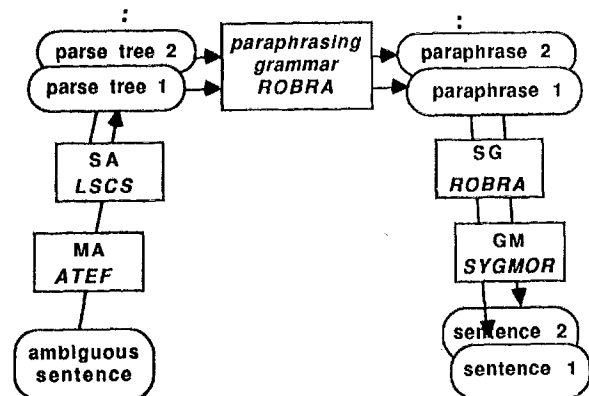
Lexical ambiguities are quite trivial to solve by presenting the definitions from a dictionary. In this paper, they are supposed to be already solved. Structural ambiguities are treated after a complete parse. In a practical setting, the best strategy would probably be to produce a complete parse, to solve lexical ambiguities and then to solve structural ambiguities for the remaining parses.

We propose, for some types of ambiguities that can arise, paraphrastic transformations that make ambiguous relations explicit.

Generation of paraphrases

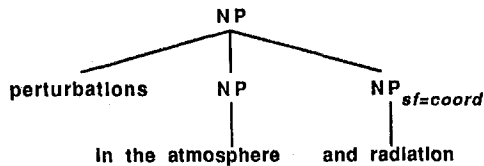
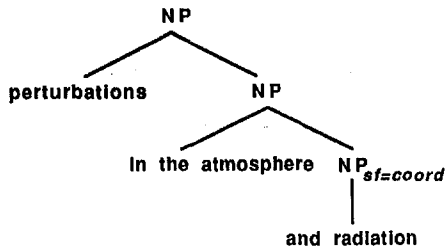
Each parse tree will be sent to a paraphrasing grammar, written in the ROBRA transformational system [Boitet & alii 80]. Then, each paraphrased tree will be sent to a generator to produce the corresponding string. The whole process is very similar to a second generation translation process, the transfer step being replaced by a

paraphrasing step, the generation being for the same language as the source language. The process is illustrated below.



C. SOME EXAMPLES OF PARAPHRASTIC TRANSFORMATIONS

1. Scope of coordination. The nominal phrase "perturbations in the atmosphere and radiation" may have two interpretations as shown below.



Presenting the phrase structure as parenthesized structure, we may have :

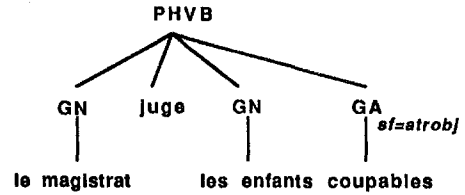
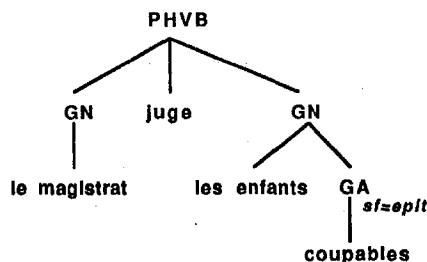
1. (perturbations (in the atmosphere (and radiation)))
2. (perturbations (the atmosphere) (and radiation))

This kind of presentation (or a similar projective scheme) is used in the DLT project of BSO (personal communication, 1987) and in [Tomita 84]. A conjunction of coordination can be used to "factorize" a phrase. The explanation of the scope of the coordination will be the "development" and the permutation of the factorized terms. The presentation using the paraphrasing scheme would be as follows :

> perturbations in the atmosphere and radiation

1. perturbations in the radiation and perturbations in the atmosphere
2. radiation and perturbations in the atmosphere.

2. AP as NP complement or VP complement: "Le magistrat juge les enfants coupables"

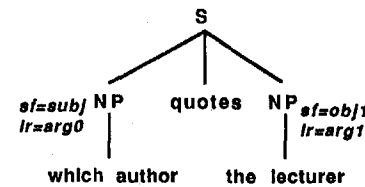
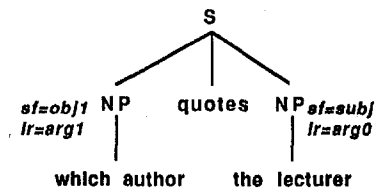


Using explicit paraphrasing of the determination with a relative pronoun, we may have :

> le magistrat juge les enfants coupables

1. le magistrat juge les enfants qui sont coupables
(the magistrate judges the children who are guilty)
2. le magistrat juge que les enfant sont coupables.
(the magistrate judges that the children are guilty)

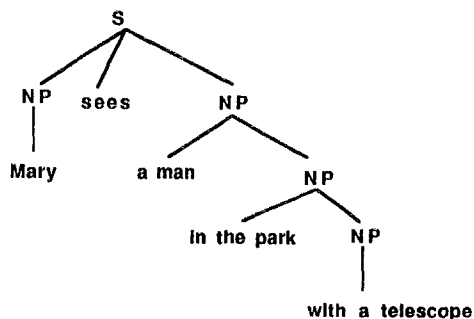
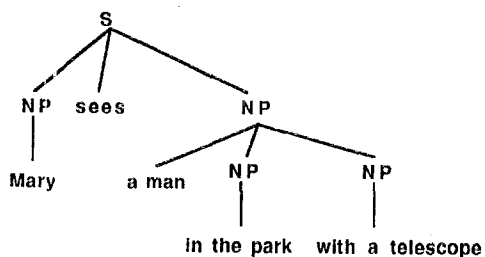
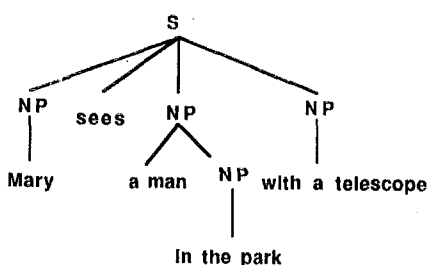
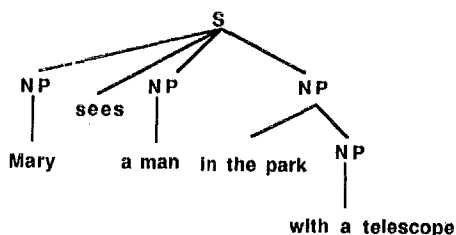
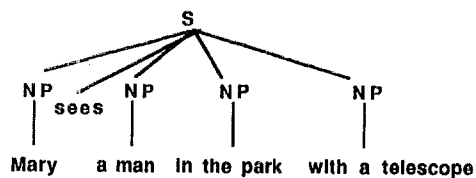
3. **Subject and object.** The sentence "Which author quotes this lecturer ?" may have two interpretations. *sf* is the syntactic function whose value may be the subject (*subj*) or the first object (*obj1*) of the governor of the sentence, "quotes". There is also an ambiguity with the argument place (*arg0*, *arg1*) for logical relations (*lr*). In this case, we may present the structures normalizing the sentence to active declarative form. Note that the phrase structures in this example are identical.



> Which author quotes this lecturer ?

1. the lecturer quotes the author
2. the author quotes the lecturer

4. **A well known example.** The sentence "Mary sees a man in the park with a telescope" may have six different interpretations as below.



For paraphrasing, we have to move circumstantials ahead and if there is more than one, to coordinate them. We have also to make noun phrase determinations explicit by using relative pronouns and, if there is more than one determination for the same noun phrase, we coordinate them. We should have then :

> Mary sees a man in the park with a telescope

1. with a telescope, in the park, Mary sees a man
2. in the park which has a telescope, Mary sees a man
3. with a telescope, Mary sees a man who is in the park
4. Mary sees a man who has a telescope and who is in the park
5. Mary sees a man who is in the park which has a telescope

Conclusion

We have presented a new approach for interactive translation based on the paraphrasing of ambiguous sentences. Compared to others [Ducrot 82, Melby & alii 80, Tomita 84], this proposal makes a step forward to the user level of understanding, transferring part of the burden of interaction from the man to the machine : no special linguistic knowledge is required but the simple (!) everyday competence of the user of language. This could be realized using only linguistic paraphrastic transformations on the output of the parser.

Some simple examples have been presented using quite simple transformations : in the case of ambiguous PP attachment there are two possibilities : (1) the PP modifies a noun phrase and this could be made explicit by using a relative pronoun; (2) the PP modifies the sentence and it can be moved ahead of it.

A set of paraphrastic transformations is now being developed to be able to write a transformational grammar that will allow experiments on a corpus.

Notes

1. In the case of technical documents, the operator (linguist, translator or documentalist) may not have enough knowledge to solve some question. For example, in the sentence "the experiment requires carbon and nitrogen tetraoxyde" [Gerber & Boitet 85], the scope of "and" is ambiguous and we may read either "carbon tetraoxyde and nitrogen tetraoxyde" or "nitrogen tetraoxyde and carbon". To be able to choose correctly, we have to know that carbon tetraoxyde does not exist in ordinary chemistry. But again, this conclusion could be false in a very special setting, e.g. an experiment described by the text in which carbon tetraoxyde is being produced as an (unstable) intermediate product of th reaction!
2. It may be possible to organise the interaction simply by presenting the set of definitions of the transfer dictionary for each unit having

several equivalent in the target language, and ask the author to choose one of them.

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