An experimental Japanese interface to a systemic grammar for generation of English auxiliary verbs

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Abstract

The paper describes an experimental graphical human/computer interface. It shows a new approach to machine translation for monolinguals, which supports interactive foreign-language generation and post-editing.

By making functional choices using bilingual menus, Japanese users can interactively generate short English sentences containing complex auxiliary verb groups like "might have done", "ought not to be doing". The generated sentences can also be revised under the control of the interface.

The functional choices are specified by a systemic grammar of the target language. The benefits of using an interactive, functional approach in machine translation are discussed.

1 Introduction

1.1 Machine Translation

The motivation of the work is improved quality of English output from Japanese-English machine translation systems. [Tsujii 86] sets out 3 problems which machine translation research needs to solve to achieve this improvement (here restricted to Japanese-English):

1. The definition of a set of factors of various aspects of meaning (semantic, pragmatic, discourse...) which collectively determine the surface structure of English texts,

2. The design and implementation of a method for generating the specific English text determined by a given set of values of these factors,

3. The investigation of methods for correctly deciding the values of these factors, including not only analysis of the Japanese source text but also other methods, such as interactive user participation.

1.2 Systemic Functional Grammar

Systemic linguists have worked on problem 1 for many years, mainly applied to TEFL. I have taken a small-scale published example from recent UK systemic work on problems 1 and 2 as a starting point for an experiment on problem 3.

[Fawcett 88] gives a convenient systemic mini-grammar for generation of English auxiliary verbs. By traversing the grammar network from left to right, making choices in each system, a set of values of various factors is selected. The realization rules for the selected values then generate the structures and words of the output sentence.

A systemic grammar network provides a definition of a set of factors of various aspects of meaning which collectively determine the surface structure of English texts, as in Tsujii's problem 1. The realization rules define a method for generating the specific English text determined by a given set of values of these factors, as in Tsujii's problem 2.

1.3 Implementation of the experimental interface

To investigate interactive user participation, as in Tsujii's problem 3, I have developed a bilingual Japanese/English graphical X Window System interface for user interaction by pointing.

There are two main reasons for using X Window System. First, the user can make his functional choices very easily, simply by clicking the mouse pointer on the desired menu item. Second, a summary of the selected feature values can itself be used as a menu, to allow easy revision of the choices.

In my implementation, the systemic grammar network and realization rules are written in a simple Prolog-based notation. The grammar network traversal and structure realization are per-
formed by Prolog programs. The X Window System menus and feature tables are implemented in the C programming language. The mini-grammar used for this experiment is taken unchanged from [Fawcett 88].

2 Using the interface

2.1 To generate a new sentence

When starting to generate a new sentence, the grammar network is entered at “situation” (see [Fawcett 88] for an explanation of how the grammar works). This leads to menus for 5 parallel systems (TRANSITIVITY, CONTINUINGPERIOD, MOOD, POLARITY, INFORMATIONFOCUS). Choices from all these menus will be required, but subsequent menus are only presented when previous choices lead to them. So the requests for functional choices are driven entirely by the systemic grammar of the target language (English).

The menus which present the required functional choices to the user are in both Japanese and English. The intended user is a Japanese speaker with an inexpert knowledge of English. The menus include brief canned-text bilingual paraphrases intended to help the user make the right choice to express his or her communicative intent. See Figure 1

![Figure 1: An example menu](image)

When the grammar network traversal is finished, the set of selected feature values is used by the realization rules to generate the structures and words of the English sentence. The generated sentence is displayed (in English only) with a summary table of the features which it realizes. The summary table shows the feature names in both English and Japanese. See Figure 2

![Figure 2: An example sentence](image)

2.2 Random generation

Alternatively, the choices at each system choice point in the grammar network may be made probabilistically. In this mode, probability values written in the grammar network are used with random numbers to traverse the network. The randomly generated sentence is displayed with its feature summary table, as in menu-driven generation, and can be revised in the same way.

A future possibility is a combination of probabilistic and menu-controlled feature selection modes, in which the machine will start to generate a stream of English sentences in the probabilistic mode. As the user gradually makes functional choices by menu, these will replace the probabilistic ones, and the stream of sentences will gradually become less random, and converge towards the expression of the user’s communicative intent. Compare the multiple alternative translations of Aidtrans described in [Wood & Chandler 88].
2.3 To revise an existing sentence

The feature summary table may be used for iterative revision. It is an array of subwindows, so it can be used directly as a menu. Any feature to be revised may be selected simply by clicking on its subwindow with the mouse. The bilingual functional choice menu for this feature is then presented again, and a new value for the feature may be chosen from it.

This choice may lead to further choices from subsystem menus, until the network traversal is completed. Then the realization rules generate a new sentence, which realizes the same features as the old sentence, except for the changed feature and any subfeatures.

For example, from the summary table in Figure 2, the user might click on AGENTOVERT-NESS. The AGENTOVERT-NESS choice system will then be entered and the Agent Overtness menu (Figure 3) will be presented.

If the user selects covertagent instead of overtagent, the network traversal is complete, so the realization rules will generate the revised sentence. It will be displayed with its summary table. See Figure 4.

After the new sentence is displayed, another feature may be revised. If the user clicks on SUBJECTTHEME in the new summary table, the SUBJECTTHEME system will be entered and the Subject Theme menu (Figure 5) will be presented.

If the user now selects agentstheme instead of affectedstheme, another revised version of the sentence will be generated. See Figure 6. This revision loop may be repeated as often as desired.

3 Application to Machine Translation

3.1 Generation as “MT Without a Source Text”

Transfer-based machine translation systems tend to be “source structure bound”, when the target structure is based too closely on the source structure. Interlingua-based machine translation systems tend to be “target structure bound”, when the target structure is based on canonical ordering which fails to express the functional sentence perspective of the source text. Instead, a functional approach to machine translation treats structure as only a syntagmatic realization of paradigmatic choices in source and target functional systems.
A functional, but non-interactive, machine translation system would tend to be “source system bound”, because the only available information comes from an analysis of the source text. This can reveal the choices made in the functional systems of the source language, but cannot decide all the choices to be made in the functional systems of the target language.

This experimental interface shows an approach to generating target sentences entirely without a source text, by directly navigating the functional systems of the target language. Because the generation of the target sentence is driven entirely by the target grammar, there is no interference from the source structure. The results are still “target system bound”, because the user can only make choices which are available in the systems of the given grammar network. Compare the canned text approach of [Somers et al 90].

To use this approach in machine translation with a source text, an analysis of the source text would be used to make preselections for the target language grammar network traversal. This depends on being able to establish correspondences between the results of the analysis and the target functional systems, which would be easier if the analysis was itself functional. But even a formal or semantic analysis could be used to make some preselections. Other functional choices in the target language would still be made by the user, where the necessary information is not in the source text at all.

3.2 Revision as “Knowledge-Based Post-Editing”

Most machine translation systems rely on post-editing by a target language expert. Post-editing is normally done with an ordinary word processor, which allows the post-editor to make totally uncontrolled changes, and gives no linguistic assistance to the task.

For example, in English, changing a noun from singular to plural may also require a change in the determiner, a change in verb agreement, and changes in subsequent pronouns. The post-editor must have sufficient target language knowledge to do all this correctly, as well as the subject domain knowledge that there are more than one of the things referred to by the noun.

The functional, menu-based revision of an existing sentence, described above, suggests a new approach towards post-editing. Instead of changing the surface forms of the words, the post-editor can change the functional choices in the target language systems. Compare the interactive pre-editing approach of Ntran, described in [Wood & Chandler 88].

The knowledge of the target language functional systems (and their internal relationships) is built into the systemic grammar network. The knowl-
edge of target language structures (and their relationships to the functional systems) is built into the realization rules.

4 Conclusion

All this knowledge can be held in the machine, so the human user should no longer need to be a target language grammar expert. This approach seems to offer a good solution to some problems, for example automatic subject-verb agreement when the subject is changed in post-editing.

The hard part is how to help the monolingual user to understand those functional distinctions which are not made in the user’s language. For this problem, work in foreign language teaching and computer-assisted language learning is relevant. In the case of English, the TEFL work of systemic linguists is of particular value.

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References


