English Adverb Generation in Japanese to English Machine Translation

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Abstract

This paper proposes an English adverb ordering method based on adverb grammatical functions (subjuncts, adjuncts, disjuncts and conjuncts) and meanings (process, space, time etc.), preferred positions in sentences (initial, medial, end, pre, post), and priorities between adverbs with the same preferred position.

1 Introduction

Adverbs[1] have various complex grammatical functions in sentences but they do not construct the main parts of sentence meaning. In natural language processing, therefore, the study of adverbs has not developed very far to date.

Linguists have examined adverb grammatical functions and meanings in detail (Quirk et al., 1985) (Greenbaum, 1969). Our method is based on these studies about adverb grammatical functions and meanings. Other adverb studies by linguists include studies which handle the meanings of specific adverbs, such as *"even "*, *"still"* and *"already "* and temporal adverb studies which handle temporal semantics in sentences.

The main problems in adverb processing in Japanese to English machine translation (Ogura et al., 1993) are as follows:

1. the multiplicity of adverb meanings
2. differences in expression between Japanese and English for adverbial meaning
3. word ordering of English adverbs in English generation
4. representation of adverbs in a computer

In this paper, we focus our attention on the 3rd problem.

2 Classification of English Adverbs

2.1 Position

In our adverb position system for English adverb generation, 5 positions are provided. The first is initial position (IP), the beginning of the sentence. The second is medial position (MP), between the subject and predicate, or if auxiliary verbs are involved in the sentence just after the first auxiliary

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[1] In this paper, adverbs include idiomatic adverbial phrase, such as "on purpose".

verb. The third is end position (EP), after a predicate. Pre position (PreP) and post position (PostP) are provided for adverbs as modifiers. A pre position adverb comes before a modificant and a post position adverb comes after a modificant.

2.2 Classification

Adverbs can roughly be divided into subjuncts, adjuncts, disjuncts and conjuncts by their grammatical function. We classify adverbs by specifying differences in meaning and preferred positions within sentences for each adverb. The classification is shown in Figure 1.

Subjuncts
    Viewpoint, Courtesy,
    Subject-orientation Item General
                       Volitional MP & EP
    Focusing Restrictive PreP & PostP,
    Additive PreP & PostP & EP & IP & MP,
    Emphasizers PreP & EP,
    Amplifiers PreP & PostP & EP,
    Downtoners PreP & EP,
Adjuncts
    Manner, Means, Instrument, Position, Direction,
    Time-position MP & EP,
    Span MP & EP,
    Time-frequency Definite,
    Indefinite MP & EP
Disjuncts
    Style,
    Content Value Judgment Non-subject,
                      Subject,
      Degree of truth
Conjuncts IP & EP
Post Position Numeral Modifiers

Figure 1: Adverb Classification

3 Word Ordering Method for English Adverbs

Adverbs usually have many meanings, especially adverbs which are used frequently in our daily life. Normally the difference in meaning is indicated by the position in the sentence.

The position of an adverb depends not only on the adverb's meaning but also on the relationship between the adverb and other sentence elements.

Figure 2 shows order priorities in adverb position, for when two or more adverbs come in the same position. ⇒ shows the priority at some position, the left

side of the right arrow comes before the right side of the right arrow in the sentence. The priority reflects the scopes of adverbs. For example, conjuncts usually have wider scope than disjuncts, so conjuncts come before disjuncts at the initial position.

Initial position
    Conjuncts ⇒
    Style Disjuncts, Content Disjuncts ⇒
    Viewpoint Subjuncts,
    General Subject-orientation Item Subjuncts ⇒
    Additive Focusing Subjuncts

Medial position
    Indefinite Time-frequency Adjuncts ⇒
    Time-position Adjuncts ⇒
    Span Adjuncts ⇒
    Volitional Subject-orientation Item Subjuncts,
    Courtesy Subjuncts ⇒
    Additive Focusing Subjuncts

End position
    Amplifiers, Downtoners ⇒
    Manner & Means & Instrument Adjuncts ⇒
    Direction Adjuncts ⇒
    Position Adjuncts ⇒
    Span Adjuncts ⇒
    Definite Time-frequency Adjuncts,
    Indefinite Time-frequency Adjuncts ⇒
    Time-position Adjuncts ⇒
    Volitional Subject-orientation Item Subjuncts ⇒
    Emphasizers ⇒
    Additive Focusing Subjuncts ⇒
    Conjuncts

Figure 2: Word Order of Adverbs

4 Experimental Results

4.1 Experiment 1

The first experiment is performed on sentences with at least one Japanese adverb taken from the "Dictionary of Basic Japanese Usage for Foreigners". The sentences are translated by a human translator. We manually examined whether English adverbs in the translation would be generated correctly using the proposed method. The results of experiment 1 are shown in Figure 3.

Examined Objects
    Japanese adverb entries: 362 words
    sentences: 1,906 sentences
    English adverbs translated from
    Japanese adverbs: 1,053
Accuracy rate 97.3%
Adverbs generated in incorrect positions 28(2.7%)
    absolutely incorrect position: 12 (1.1%)
    strange position: 16 (1.5%)

Figure 3: Results of Experiment 1

This experiment confirmed that the proposed word ordering method can handle large amount of adverbs correctly.

4.2 Experiment 2

The second experiment had the Japanese to English machine translation system ALT-J/E translate Japanese sentences to test various English adverb functions. The goal was to confirm that this adverb ordering method could handle various types of English adverbs.

The experiment considered 200 arbitrary sentences which ALT-J/E was known to analyze correctly. This method was compared to a previous version of ALT-J/E which did not use adverbs' grammatical functions and meanings but only this preferred adverb positions. The result is as follows.

Table 1: Results of Experiment 2

Method	Accuracy rate	COS
This Method	98%	196
Previous Method	86%	172

COS = Correctly ordered sentences
Improved Sentences: 27 (13.5%)
Sentences changed for the worse: 3 (1.5%)

5 Conclusion

A new adverb classification based on adverb grammatical functions, meanings and adverb preferred positions for English adverb generation in machine translation was proposed. The effectiveness of the English adverb ordering method in Japanese to English machine translation based on the adverb classification and the priority of the same adverb preferred positions is shown. The priority was decided by examining sentences with adverbs to generate English adverbs in Japanese to English machine translation. If correct English adverbs are selected after Japanese analysis and Japanese to English transfer, about 97% of adverbs can be put correct positions in sentences by this adverb ordering method. Compared with the previous adverb ordering method, the accuracy rate of the proposed method is improved 12%. The proposed method can also be used for adverbial prepositional phrases.

References

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