

Simultaneous Spoken Dialogue Translation

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Background

- Increased opportunities for global communication
 - International business
 - Overseas travel

Speech-to-speech translation system is ideal to support such communication

Speech-to-Speech Translation

- One of the most important research topics for language processing
- Several experimental systems have been developed
 - ATR-MATRIX
 - Automatic Interpretation System for Travel Conversations

Consecutive Translation System

It can't provide an environment for supporting smooth and natural dialogue

Simultaneous Translation System

Utilizing Free Word Order In Japanese

Source : I want to fly from San Francisco to Denver next Monday

Translation1 : 来週の月曜日にサンフランシスコからデンバーへ乗りみたいです。

Translation2 : サンフランシスコからデンバーへ乗りみたいです、来週の月曜日に。



Source: I want to fly from San Francisco to Denver next Monday

Translation1: 来週の月曜日にサンフランシスコからデンバーへ乗りみたいです。

Translation2: サンフランシスコからデンバーへ行きへ 乗りみたいです、来週の月曜日に。

Deciding the Word Order of Japanese Translation

Based on Dependency Relations

Constraints of Dependency in Japanese

Three constraints of the dependency in Japanese

- No dependency is directed from **Right-to-Left**
- Dependencies do **not cross each other**
- Each "bunsetsu" does **not no more than one head "bunsetsu"**



Inversions

The inversions happened easily in Japanese spoken language

Three features of Inversions in Japanese spoken language

- The type of head "bunsetsu" is **predicate**.
- The more increased the number of the dependencies which depend one "bunsetsu", the more easily the inversions happens.
- The number of inversion in a utterance is **at most two**.



How to Decide Word Order of Japanese Translation

Output the predicate

Input: I want_to_fly from San Francisco

Output: nil サンフランシスコから 乗りみたいです

Three inversions occur

Input: I want_to_fly from San Francisco to Denver with my friend next Monday

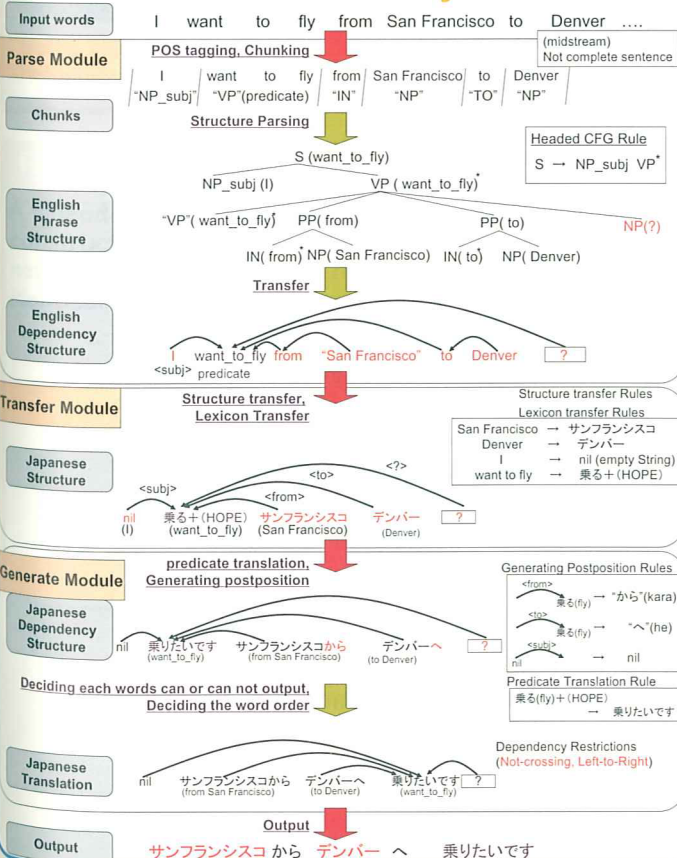
Output: nil サンフランシスコから 乗りみたいです デンバーへ 友達と一緒に 来週の月曜日に

The Correction

Input: I want_to_fly from San Francisco to Denver with my friend next Monday

Output: nil サンフランシスコから 乗りみたいです デンバーへ 友達と一緒に 来週の月曜日に 乗りみたいです

Structure of MT System



Experiment

The outline of experiment

- Input data** : 578 sentences in ATIS corpus were used in the experiments.
- PC Environment** : Windows Note PC (Pentium M 1GHz, 512MB RAM)

The evaluation on translation quality

- (A) **Perfect** : no problems in both information and grammar.
- (B) **Fair** : easy-to-understand with some unimportant information missing or flawed grammar.
- (C) **Acceptable** : broken but understandable with effort.
- (D) **Nonsense** : important information has been translated incorrectly

The evaluation on simultaneity

$$Delay = \frac{\sum d_k}{n}$$

d_k : an elapsed time from input the k th word until output its translation word.

n : the number of words in a source sentence

Translation Quality

Translation Quality	A	A+B	A+B+C	D
The Number of Sentence	38 (6.57%)	288 (49.83%)	503 (87.02%)	75 (12.98%)

Average Delay

Average Delay	Consecutive	Our method
	3.75	2.61

Conclusions

- Proposed the method of deciding the word order of Japanese Translation
 - Utilizing three constrains of modifications in Japanese
 - Utilizing the Inversions
- Presented the structure of Simultaneous MT System.

Future Works

- Decreased the delay by utilizing the inversions positively
 - Utilizing the function words to decide the word order
 - Learning the conditions statistically that the inversions occur.
- Apply our method to other languages