NTT-UT SMT System for NTCIR-9 PatentMT

Katsuhito Sudoh, Kevin Duh, Hajime Tsukada, Masaaki Nagata
NTT Communication Science Laboratories
Kyoto, Japan

Xianchao Wu, Takuya Matsuzaki, Jun’ichi Tsujii
The University of Tokyo
Tokyo, Japan
# Overview

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<thead>
<tr>
<th>task</th>
<th>English-Japanese</th>
<th>Japanese-English</th>
<th>Chinese-English</th>
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| single system features | • Pre-ordering  
• Big LM  
• WFST decode | • Pre-ordering | • WA Adaptation |
| rank      | 1st                                      | 5th                      | 9th                        |

**English-Japanese**
- Pre-ordering
- Big LM
- WFST decode

**Japanese-English**
- Pre-ordering

**Chinese-English**
- WA Adaptation
# Overview

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Better than RBMT even in Subjective Evaluation!!!
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+ U-Tokyo forest-to-tree |                | Sys. Comb.  
+ U-Tokyo BMIT |
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Better than RBMT even in Subjective Evaluation!!!

**Today’s Focus!**
Head Finalization for En-Ja pre-ordering
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- Isozaki et al. (WMT 2010)
Head Finalization for En-Ja pre-ordering

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- Moving heads to rhs on HPSG tree
  - English HPSG Parser “Enju” (U-Tokyo)
Head Finalization for En-Ja pre-ordering

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• Pseudo-word insertion for Ja particles
  • Predicate-argument structure by Enju
Head Finalization for En-Ja pre-ordering

- Isozaki et al. (WMT 2010)
- Moving heads to rhs on HPSG tree
  - English HPSG Parser “Enju” (U-Tokyo)
- Pseudo-word insertion for Ja particles
- Predicate-argument structure by Enju
- Determiner (a/an/the) deletion
I lost my wallet in the airport yesterday.
Head Finalization Example

I lost my wallet in the airport yesterday
I lost my wallet in the airport yesterday.
Head Finalization Example

I yesterday the airport in my wallet lost

• Move Heads
Head Finalization Example

I yesterday the airport in my wallet lost

- Move Heads
- Remove a, an, the
I lost my wallet in the airport yesterday.

- Move Heads
- Remove a, an, the
- Insert pseudo-particles for subjects & objects
I lost my wallet in the airport yesterday.
I _va0 yesterday airport in my wallet _va2 lost

私は 昨日 空港 で 私の 財布 をなくした
Head Finalization Example

I lost my wallet in airport yesterday.

Monotone Translation !!
Japanese Big LM

- Word 5-gram LM from 300M Ja sentences
WFST-based Monotone Decoding
WFST-based Monotone Decoding

- MT becomes monotone by pre-ordering
WFST-based Monotone Decoding

• MT becomes monotone by pre-ordering

• Efficient decoding by WFST
WFST-based Monotone Decoding

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- Efficient decoding by WFST
- phrase segmentation > phrase translation > word segmentation > LM
WFST-based Monotone Decoding

- MT becomes monotone by pre-ordering
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  - phrase segmentation > phrase translation
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- Efficient on-the-fly composition
WFST-based Monotone Decoding

- MT becomes monotone by pre-ordering
- Efficient decoding by WFST
  - phrase segmentation > phrase translation > word segmentation > LM
- Efficient on-the-fly composition
- ~3x faster than Moses PBMT
Generalized MBR-based System Combination
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- Duh et al. (IJCNLP 2011)
Generalized MBR-based System Combination

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- Hyp. selection on $N$-bests on $M$ systems
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- Sub-components on RIBES & BLEU
Generalized MBR-based System Combination

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- Hyp. selection on $N$-bests on $M$ systems
- Optimization in RIBES+BLEU
- System-independent “agreement” features
  - Sub-components on RIBES & BLEU
- Ranking SVM-like pairwise training
EJ Auto-Eval Results

- BLEU (%)
- RIBES (%)
EJ Auto-Eval Results

- HPBMT Baseline
- F2S (U-Tokyo)
- PreOrder (WFST)
- PO+BigLM (Moses)
- GMBR Sys. Comb.
EJ Auto-Eval Results

- **HPBMT Baseline**: BLEU 31.66%
- **F2S (U-Tokyo)**: BLEU 27.99%
- **PreOrder (WFST)**: BLEU 36.83%
- **PO+BigLM (Moses)**: BLEU 38.81%
- **GMBR Sys. Comb.**: BLEU 39.48%

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**Note**: The chart shows the BLEU scores for different systems, with higher scores indicating better performance.
EJ Auto-Eval Results

- HPBMT Baseline: BLEU 31.66, RIBES 72%
- F2S (U-Tokyo): BLEU 27.99, RIBES 68.61%
- PreOrder (WFST): BLEU 36.83, RIBES 77.29%
- PO+BigLM (Moses): BLEU 38.81, RIBES 77.82%
- GMBR Sys. Comb.: BLEU 39.48, RIBES 78.13%
EJ Subj.-Eval Results

- Adequacy
- Acceptability (%)
EJ Subj.-Eval Results

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EJ Subj.-Eval Results

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<tr>
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<td>2.60</td>
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<tr>
<td>PreOrder (WFST)</td>
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<td>3.56</td>
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<tr>
<td>GMBR Sys. Comb.</td>
<td>3.67</td>
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<td>RBMT6-1</td>
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<td>3.51</td>
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EJ Subj.-Eval Results

- **HPBMT Baseline**
  - Adequacy: 2.60
  - Acceptability (%): 47

- **PreOrder (WFST)**
  - Adequacy: 3.56
  - Acceptability (%): n/a

- **GMBR Sys. Comb.**
  - Adequacy: 3.67
  - Acceptability (%): 69

- **RBMT6-1**
  - Adequacy: 3.51
  - Acceptability (%): 66
What we found...
What we found...

- Head Finalization worked QUITE well!
- Simple but effective way for EJ translation
- Monotone translation is relatively easy?
What we found...

• Head Finalization worked QUITE well!
• Simple but effective way for EJ translation
• Monotone translation is relatively easy?
• Further improved by GMBR Sys. Comb.
• System variance (diversity) is important?
Conclusion
Conclusion

• State-of-the-art EJ translation
• even better than RBMT!
Conclusion

• State-of-the-art EJ translation
  • even better than RBMT!

• ... moderate in JE/CE
  • JE pre-ordering, CE adaptation
That’s It!

Acknowledgments

- PatentMT organizers, for all of this great task!
- Prof. Hideki Isozaki, for Head Finalization
- Dr. Takaaki Hori, Dr. Shinji Watanabe, for WFST decoding