A Comparison of Machine Translation Paradigms for Use in Black-Box Fuzzy-Match Repair

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Overview

- Fuzzy-Match Repair
- Comparison of MT Paradigms
- Results & Analysis
- Future Work
Introduction to Fuzzy-Match Repair

01 The Source Sentence (s')
The cat **blinks** when the dog arrives

02 The TM Source (s)
The cat **runs** when the dog arrives

03 The TM Target (t)
El gato **corre** cuando llega el perro

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Our Fuzzy-Match Repair algorithm will repair proposals from the TM and propose translation hypotheses closer to the source sentence.
Introduction to Fuzzy-Match Repair

The Translator
When working with fuzzy matches, the translator has to make changes to transform $t$ into an adequate translation of $s'$.

Translation Proposals
Our goal is to repair fuzzy matches and provide translation proposals so that the amount of post-editing by the translator is kept to a minimum.
FMR Algorithm

01. Align input source ($s'$) to TM source ($s$)

02. Translate mismatches

03. Match translations to their TM target ($t$)

04. Build pairs of repair operators ($\sigma', \sigma)(\tau', \tau$)

05. Generate hypotheses ($t^*$)
FMR Algorithm

The **blue** dog barks \((s^\prime \text{ source})\)
The **red** dog barks \((s \text{ tm-source})\)
El perro **rojo** ladra \((t \text{ tm-target})\)

\(\sigma^\prime\) - The **blue** dog, **blue** dog, **blue**
\(\sigma\) - The **red** dog, **red** dog, **red**
\(\tau^\prime\) - el perro **azul**, perro **azul**, **azul**
\(\tau\) - el perro **rojo**, perro **rojo**, **rojo**

El perro **azul** ladra \((t^* \text{ the best (oracle) of many hypotheses})\)
Oracle Evaluation (for FMR)

\[
\sum_{i=0}^{N} \frac{ED(t_i^*, r_i)}{\sum_{i=0}^{N} |r_i|}
\]

Get TUs that meet fuzzy-match threshold

If no TU meets threshold, use MT. Otherwise, get highest scoring TU and produce all possible hypotheses.

Select repair with minimum edit distance.
FMR Requirements

Black-Box Translation

Our approach to fuzzy-match repair allows the use of any external source of bilingual information (SBI) such as rule-based, statistical, or neural machine translation systems, dictionaries, and more ...
Introduction to Fuzzy-Match Repair

Previous Work
- FMR introduced
- Oracle evaluation on 3 language pairs

Current Work
- 3 MT Paradigms
- Oracle performance eval. & sub-segment analysis
Machine Translation Paradigms

Rule-Based (RB)
Apertium

Statistical (SMT)
Moses

Training:
- Europarl, News Commentary,
- DGT-TM 2011-13
- Large LM

Neural (NMT)
Nematus

Training:
- Europarl, News Commentary
- DGT-TM 2011-13
Results & Analysis

- Compare System Performance: Translation & Oracle FMR
- Direct Comparison of Two Best Systems
- Analysis of Sub-Segment Translations
System Performance

SMT performs best for translation...

![Graph showing WER and BLEU scores for RB, SMT, and NMT]
System Performance

SMT performs best for translation...but NMT performs best for FMR.

![Graph showing WER and BLEU scores for RB, SMT, and NMT](image)

![Graph showing WER for FMR across 60%, 70%, and 80% fuzzy-match thresholds for TM, RB, SMT, and NMT](image)
Direct Comparison: SMT vs. NMT

- **NMT is able to repair more segments**
  And it produces more repair options per segment

- **On a subset of segments that NMT & SMT both repair:**
  FMR performance is very similar between SMT and NMT

- **More repair options (NMT) gives better FMR performance**
  True under the oracle evaluation, but with a pessimal oracle, NMT suffers a greater performance drop than SMT
## Sub-Segment Translations

<table>
<thead>
<tr>
<th>Source</th>
<th>SMT</th>
<th>NMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>annex 3; it cannot be furnished</td>
<td>el anexo 3; no podrán aportarse</td>
<td>anexo 3</td>
</tr>
<tr>
<td>'s authorities shall within</td>
<td>dentro de las autoridades de</td>
<td>las autoridades de los estados miembros dispondrán de las autoridades nacionales competentes en el</td>
</tr>
<tr>
<td>( place and date )</td>
<td>( lugar y fecha )</td>
<td>( lugar y fecha )</td>
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Future Work

Fuzzy-match Repair paper presented at AMTA with initial idea and concept 2014

Black-Box MT paradigms and sub-segment analysis presented at AMTA 2018

2016
Idea formalized and algorithm released to the MT community at AMTA 2016

2018+
Formalize features for Quality Estimation in FMR to rank hypotheses with unseen reference.
Thank you!

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