Improving SMT by Using Parallel Data of a Closely Related Language

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Motivation

- The **amount of training data** in SMT critically affects **translation quality**.
- We demonstrate how to **increase** translation quality for one language pair by introducing **parallel data** from a **closely related language**.
- We improve **English→Slovak** translation using:
  - a large Czech–English parallel corpus and
  - a shallow MT system for Czech→Slovak translation.

Related Work – Pivoting

- Several concepts of using pivot or intermediate languages to improve MT quality:

  1) **combine the models** (phrase tables) of two translation systems (from the source to pivot language and from pivot to target language),
  2) **“triangulation”**, where the MT systems based on different pivot languages have to agree on the translation,
  3) **cascading** – combining the lists of the best translations – or creating artificial parallel data.

- Especially helpful if the pivot language is **closely related** to the source or target language and when only a small amount of parallel data is available for the source or target language [Babych et al., 2007].

MT Systems Used

- **Česílko 1.0**
  - Stand-alone MT system designed for closely related languages.
  - Supports only **Czech→Slovak** language pair.
    - Česílko 2.0 supports more pairs but performs worse for **cs→sk**.
  - Steps:
    1) Czech morphological analysis + statistical tagging,
    2) Simple dictionary for transfer,
    3) Slovak morphological generation.
  - Relies on the similarity of the languages in question,
    - e.g. it **does not change word order** during the translation.
  - Chosen because it performed well in a comparison of several **cs→sk** translation systems - fairly **robust** to various input text types.

MT Systems Used

- **Moses**
  - Open source phrase-based statistical machine translation system.
  - Used:
    - as the baseline direct **en**→**sk** translation,
    - for the various configurations of pivoting.

Training Data

- **CzEng**
  - http://ufal.mff.cuni.cz/czeng/
  - Freely available English–Czech parallel corpus.
  - Compiled from different type of sources.
  - We use version 0.9, but there is now a twice as big version 1.0.
  - We translated the Czech side into Slovak using Česílko 1.0.
- **English-Slovak Parallel Corpus**
  - http://hdl.handle.net/11858/00-097C-0000-0006-AADF-0
  - Compiled from freely available sources: Acquis, European Commission Website and parts of OPUS Corpus (EMEA, EUconst, KDE4 and PHP).

Training Data Sizes

	CzEng			En-Sk Corpus	
	English	**Czech**	**Slovak (MT)**	**English**	**Slovak**
Sentences	7.15 mil	7.15 mil	7.15 mil	2.46 mil	2.46 mil
Tokens	85.09 mil	72.86 mil	72.96 mil	52.09 mil	46.81 mil

Test Data (1/2)

- Derived from the **WMT 2011** shared task test data.
- Consists of **newspaper articles** covering a broad range of topics.
- Multi-parallel, available in Czech, English, German, Spanish and French.
- The **source** languages of the news articles **differ**
  - each article comes from one of the five languages and it is translated sentence by sentence to all the other languages.

Test Data (2/2)

- The extended the dataset to include Slovak version:
  - **Czech version was translated into Slovak**,
  - English version was provided to the translators only for reference in ambiguous or unclear cases.
- Many **discrepancies** between the English and Czech sentences in the original WMT data were found.

	English	**Czech**	**Slovak**
Sentences	3 003	3 003	3 003
Tokens	77 086	68 108	63 730

Experiments

Setups Examined (1/2)

- **Direct Translation**
  - Statistical translation system Moses is trained and tuned on English–Slovak parallel data.
  - The resulting model is used for direct English→Slovak translation.
- **Moses+Česílko**
  - Simple MT system cascading with Czech used as the pivot language.
    - Moses is trained and tuned on the English–Czech corpus,
    - The resulting model is used for English→Czech translation, the output of which is further translated into Slovak by Česílko.

Setups Examined (2/2)

- **Česílko+Moses**
  - Synthetic parallel corpus:
    - The Czech part of the English–Czech corpus is automatically translated by Česílko into Slovak.
    - Moses is trained and tuned on this synthetic parallel corpus and the model is used for English→Slovak translation.
- **Česílko+Moses+Direct**
  - A combination of the direct and synthetic corpus approaches.
  - The training data are acquired as the concatenation of the manual English–Slovak corpus (as used in **Direct Translation**) and the synthetic English–Slovak corpus from **Česílko+Moses**.
  - This combined corpus is used for training of Moses and the model is used for English→Slovak translation.

Stemming for Word Alignment

- To overcome data sparseness.
- Only the first 4 letters of each word in both source and target languages were used for word alignment in all experiments.

Preprocessing for word alignment	BLEU	TER
Word Form	11.65 [11.04,12.27]	71.43 [70.52,71.43]
First 4 Characters	12.11 [11.51,12.75]	70.71 [69.81,71.60]

Tuning Data (1/2)

- Should we tune Moses on Slovak sentences translated:
  - from English manually, or
  - from Czech automatically using Česílko?
- A preparatory experiment using **WMT 2011** test set:
  - **The first half** serves for **tuning**, either in its **manual** Slovak version, or an **automatic** version obtained by Česílko.
  - **The second half** (always manual translation) used for **evaluation**.

Reference of the tuning set	BLEU	TER
Automatic	12.73 [12.15, 13.32]	68.80 [67.94, 69.66]
Manual	12.61 [12.01, 13.19]	68.88 [68.03, 69.77]

Tuning Data (2/2)

- Scores achieved using the **automatically translated** tuning data were slightly **better than** the results of the experiment which used **manually translated data**.
- May be **caused** by the properties of **Česílko and BLEU**:
  - Česílko translates word for word and does not change the word order → could lead to the higher scores when calculated by BLEU.
- We opted for the automatic translation because it allows us to use larger tuning and test sets for the main experiments:
  - **For tuning** we use **WMT 2010** test set **automatically translated** from Czech into Slovak using Česílko.
  - **For testing** we use the whole **WMT 2011** test set (with manual Slovak).

Results

Pivoting Experiments

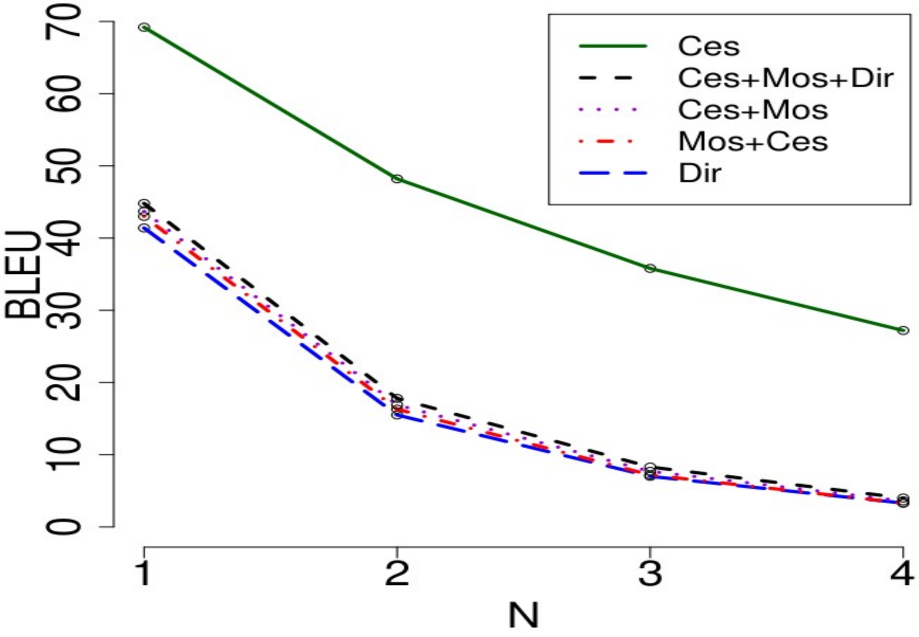
	BLEU	TER
Direct Translation	10.83 [10.39, 11.25]	72.48 [71.89, 73.14]
Moses+Česílko	11.31 [10.89, 11.71]	71.11 [70.49, 71.71]
Česílko+Moses	11.89 [11.43, 12.30]	70.49 [69.86, 71.13]
Česílko+Moses+Direct	12.61 [12.13, 13.05]	69.14 [68.51, 69.79]

Pivoting Experiments

- **Direct Translation** is **significantly worse** than the results of all the other translation schemes.
- The result of **Česílko+Moses**, in which the English–Czech corpus is translated into Slovak and then used for training, performs significantly better than the converse **Moses+Česílko** when Moses operates on English→Czech and the resulting Czech is then translated into Slovak by Česílko.
- The **best result** was achieved when **both corpora**, the smaller manual English–Slovak and the larger English–Czech automatically translated to Slovak, were used.

Detailed BLEU

- We examined the n-gram components of BLEU scores.
- The tendency is the same for all **en→sk** translations:
  - the n-gram precision decreases exponentially with n.
- Česílko **cs→sk** translation:
  - = the 2nd step in simple cascading if the 1st step were ideal,
  - reaches BLEU of 42.45,
  - n-gram precision drop flatter.
- In line with Babych et al.:
  - a **linear decrease** of the n-gram precision for **closely related languages**, and
  - an **exponential decrease** for **distant languages**.



Conclusion

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- We examined techniques for improving **English→Slovak** MT.
  - employing language resources of a closely related language, **Czech**.
- Pivoting via a closely related language performs well.
- Creating a **synthetic parallel corpus** by translating the Czech side of an English–Czech parallel corpus gave **results superior** to a simple cascading of the **en→cs** and **cs→sk** translation systems.
- The **best result** was obtained using **all available data**:
  - the parallel corpus for the direct **en→sk** translation, and
  - the synthetic **en-sk** constructed using shallow **cs→sk** MT

Thank you

Remark on Czech → Slovak

- **BLEU** score for the Česílko **cs→sk** translation is **42.45**, with the confidence interval [41.67,43.18].
  - (Measured on the very same WMT 2011 Slovak reference translations as our main **en→sk** experiments.)
- This high score may reflect:
  - text source and translation direction:
    - The Slovak version was created by translating from Czech.
    - The English version comes from various source languages.
  - properties of Česílko, manual translation and BLEU:
    - Česílko preserves the word order,
    - The translators may have pursued the same approach because they were also translating from Czech,
    - BLEU may thus give a high credit to matching n-grams