A Novel Statistical Pre-Processing Model for a Rule-Based Machine Translation System

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Outline

1. Introduction
2. Design
3. Experiments
4. Results

Introduction

- Pre-processing in general:
  - It is the first step in the translation process
  - It prepares the input for effective analysis and transfer for an MT system
  - such as: tokenisation, segmentation, dictionary customisation, Controlled Language (CL) rules, etc.
- Challenges of current pre-processing methods
  - CL (O'Brien, 2003; O'Brien and Roturier, 2007)
    - Rules are manually crafted
    - Hard for writers to implement
  - Source re-construction (Xia and MacCord, 2004; Crego and Marino, 2007; Babych et al., 2009)
    - Focus on SMT systems
    - Sometimes still need to craft rules manually
    - Limited number of rules

Introduction

A pre-processing method for RBMT system

- What do we need:
  - Source texts which can be, on the one hand as similar to the Chinese structure as possible, while at the same time, analyzable by the RBMT system
- What do we do:
  - Employ an SMT to transform the English sentence into Chinese friendly (or an RBMT system friendly) structure automatically and comprehensively without human intervention or manually crafted rules

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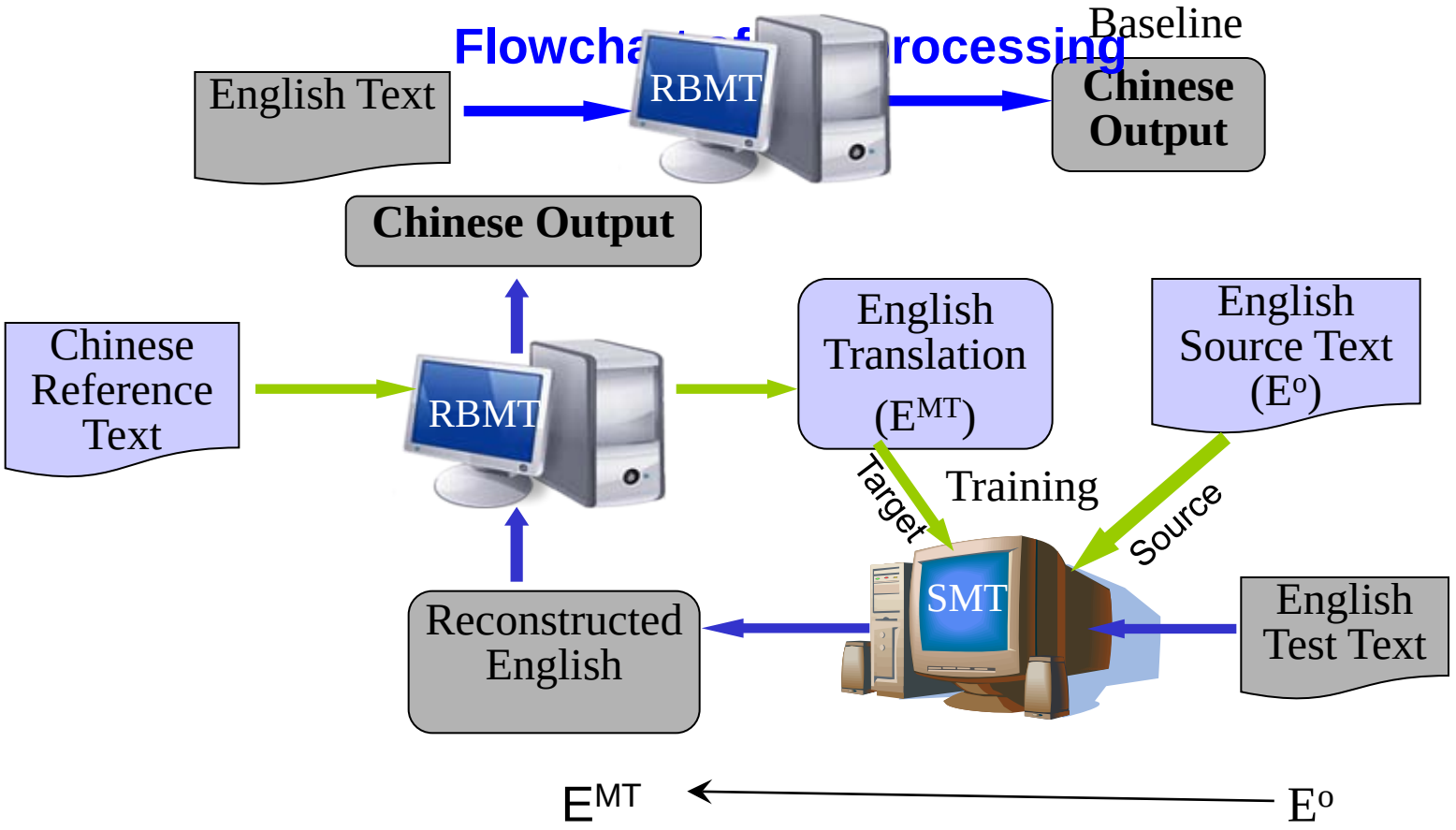
Methodology



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Outline

Experiments

- Experimental set-up
  - MT system: Systran (RBMT) and Moses (SMT)
  - Automatic Evaluation Metrics: GTM, BLEU and TER
  - Training Corpora: Four

The test set and the first corpus belong to a security corpus. The Chinese references were extracted from an in-house TM.

First type Corpus	#Sentence	#English words	#Chinese words
In_Domain	5439	77268	85501
Test Set	944	14839	16100

Second type Corpora	#sentence	#English words	#Chinese words
Mix_Tiny	5439	55846	69410
Mix_Small	9934	106457	119480
Mix_Large	269913	2787175	3382309
Development Set	903	10677	10764

To scale up the project. The whole mix-corpus TM was employed. A development corpus and three other corpora were randomly selected from the TM along with their corresponding references.

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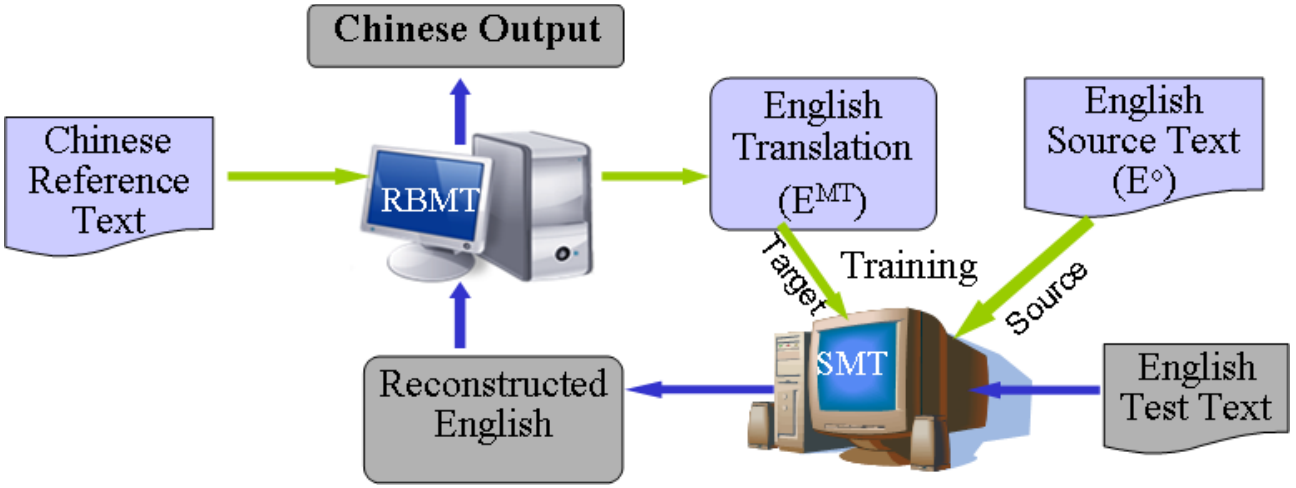
Outputs

- Baseline

- In_Domain
- Mix_Tiny
- Mix_Small
- Mix_Large



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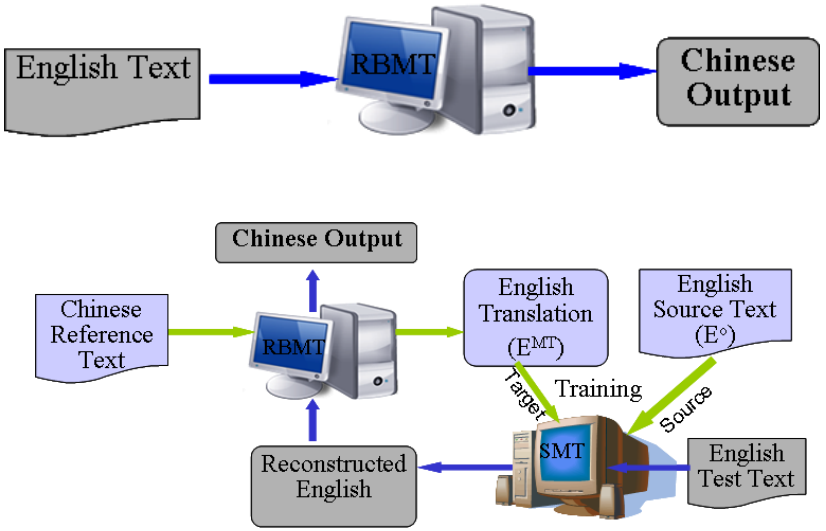
4. **Results**

Results - Scores

	GTM	BLEU	TER
Baseline	0.6565	0.2490	0.5249
Mix_Tiny	0.6553	0.2229	0.5499
Mix_Small	0.6567	0.2303	0.5436
Mix_Large	**0.6836**	**0.2746**	**0.5058**
In_Domain	0.6751	0.2646	0.5261



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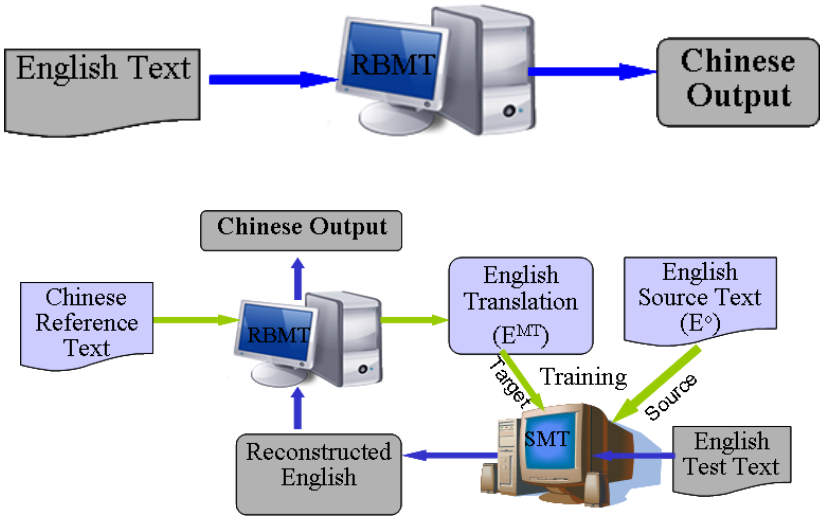

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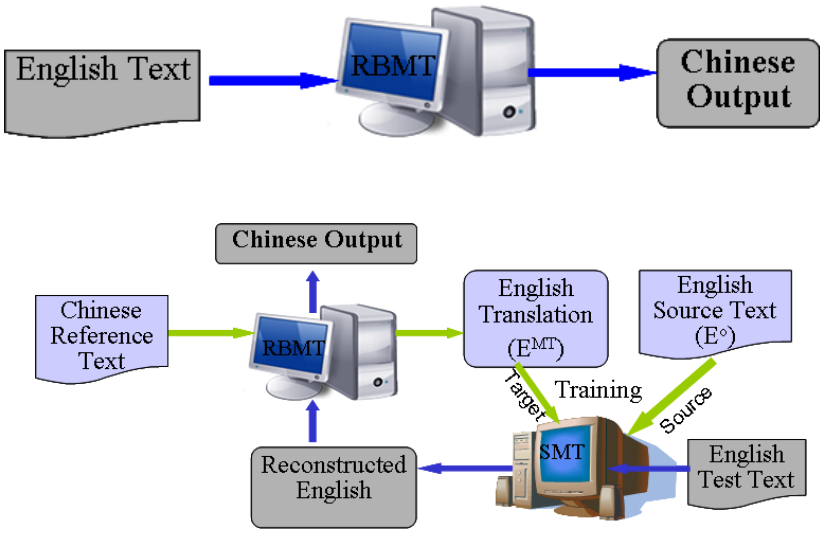

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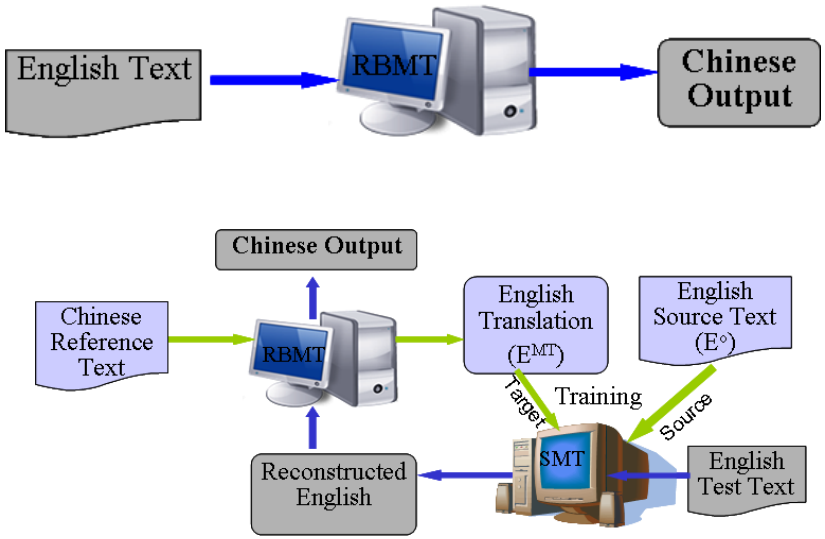
**p<0.001; *p<0.1



- The biggest corpus produced the best translation according to the scores;
- In-domain corpus is better than mix-domain corpus unless the mix-domain corpus is greatly larger than the in-domain corpus

Results – Translation Comparison

- Baseline vs. Mix_Large (the biggest corpus), an example:

Baseline (Without Pre-processing)

English Source	About the processes that proactive threat scans detect							
Ref / Baseline	关于	主动型	威胁	扫描	所	检测	的	进程
关于	■							
主动型		■						
威胁			■					
扫描				■				
的							■	
进程								■
请								
检测						■		
Gloss	About the processes of proactive threat scans please detect							

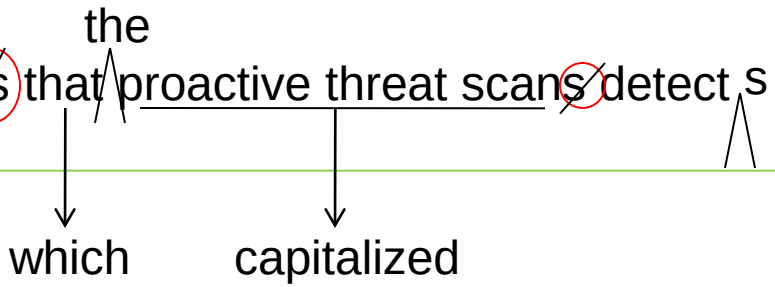
Mix_Large (With Pre-processing)

English Source	About the processes that proactive threat scans detect							
Ref / Mix_Large	关于	主动型	威胁	扫描	所	检测	的	进程
关于	■							
主动型		■						
威胁			■					
扫描				■				
检测						■		
的							■	
进程								■
Gloss	About the process that proactive threat scans detect							

Source English VS. Mix_Large English

Source sentence:

* About the processes that proactive threat scans detect s



Pre-processed sentence:

* About process which the Proactive Threat Scan detects

Source English VS. Mix_Large English

The most frequent changes made by the pre-processing model

Category (# occurred)	Example	Frequency	
Insertion (1158)	the		248
	will		46
	,		41
	”		39
	to		36
Deletion (992)	the		102
	of		85
	a		65
	that		59
	you		49
Substitution (5307)	a	the	166
	can	may	150
	computer	machine	64
	that	which	58
	click	clicks	49

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Source English VS. Mix_Large English

- 99.8% (942 out of 944) of sentences were modified
  - All the modified English sentences could be divided into three groups:

	Percentage
Correct grammar and clear meaning	25.64
Minor error and clear meaning	25.74
Incorrect grammar and fuzzy meaning	48.31

Source English VS. Mix_Large English

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Question: Which group of sentences produce most of the improvements?

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Source English VS. Mix_Large English

Pilot Human Evaluation

- 3 students on 100 sentences
- Compare the translations of sentences within each group to the baseline translation
- Calculate the improvements and degradations ratios

	Improvements / Degradations
Correct grammar and clear meaning	0.6970
Minor error and clear meaning	0.7941
Incorrect grammar and fuzzy meaning	0.5517

No significant difference between baseline and pre-processed translation

Conclusions

- Automatic pre-processing for RBMT system can be conducted using an SMT system
- An increase of about 10% automatic scores were reported
- In-domain corpus performs better than the same sized or slightly bigger mix-domain corpora but not as good as huge corpus
- Degradations were generated by the SMT system

Next steps

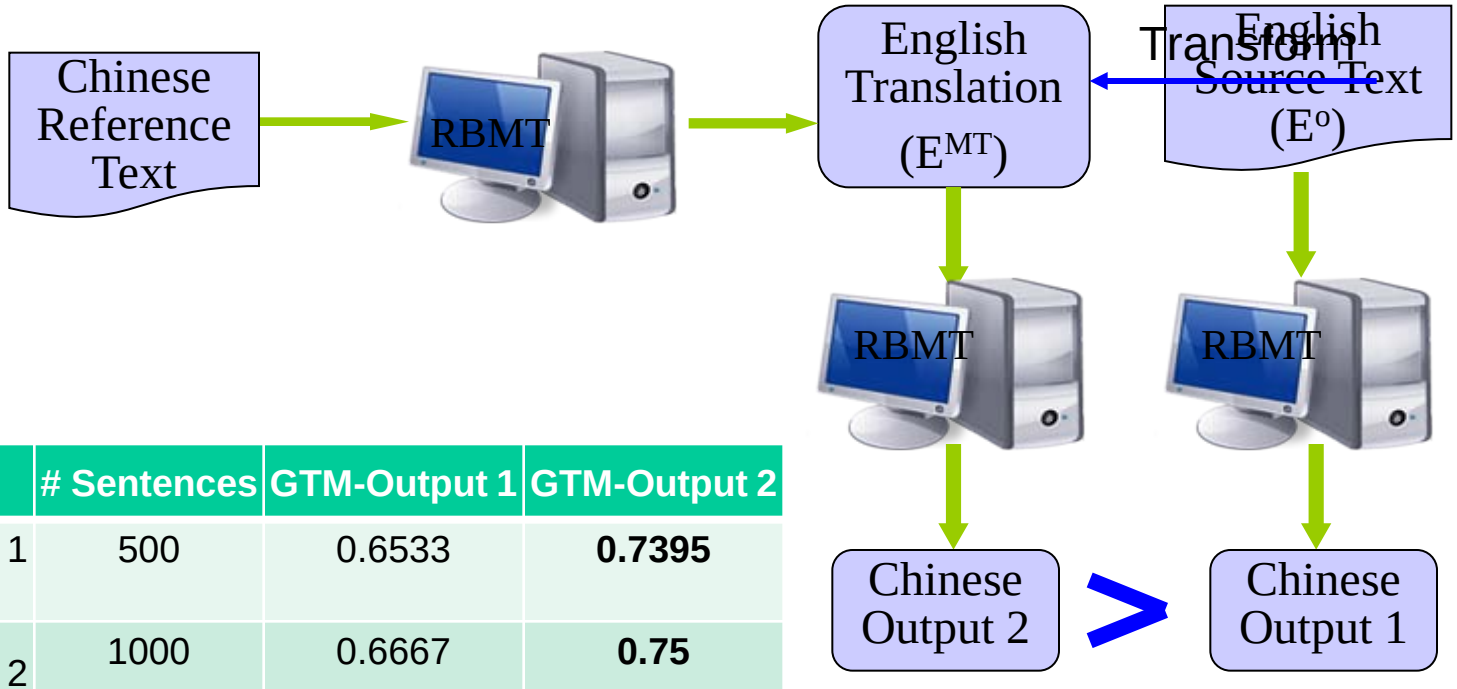
- How to improve the performance of the model
  - Regulate the SMT system to only pre-process sentences meeting certain criteria?
  - Regulate the RBMT system to translate only grammatical or ungrammatical sentences?
  - Use cleaned and balanced corpora?

Questions?

Suggestions?

Thanks!

Rationale



	# Sentences	GTM-Output 1	GTM-Output 2
Sample 1	500	0.6533	**0.7395**
Sample 2	1000	0.6667	**0.75**

Result – Linguistic Analysis

- 99.8% (942 out of 944) of sentences were modified
  - All the modified English sentences could be divided into three groups:

1. Correct English grammar and clear meaning (25.64%)
   - Keep the original meaning (80%), e.g.

     Source: You know that the process is safe to run in your environment.

     Pre-processed: You know that the procedure is safe to run in your conditions.

     - Changed meaning (20%), e.g.

     Source: You configure Auto-Protect settings as part of an Antivirus and Antispyware Policy.

     Pre-processed: You configure the auto-Protect settings in antivirus and antispyware tactic.

Result – Linguistic Analysis

2. Minor English grammar error and understandable meaning (25.74%):
   - All sentences keep the original meaning

     Source: Auto-Protect then scans the files if you request them from the remote computer again.

     Pre-processed: The auto-protect will scan this file, if your request them from the remote machine once more.

3. Incorrect English grammar and hard to comprehend (48.31%)

   Source: After Policy name, type the name of the policy (it shows New Host Integrity Policy by default).

   Pre-processed: After policy name, the type policy name (displays “new Host Integrity Policy” default).