Fast Realization of Automatic Translation Systems for New Mission-Relevant Languages

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Outline

1. Introduction
2. Rough translation
3. Concept for the rapid realization of translation systems
4. Language pair Dari – German as an example
5. Conclusion, References

1. Introduction – I

- Military operations: documents written in foreign languages are relevant.
- The information in the documents might be of great value for the military analyst.
- Foreign languages can be an obstacle.

1. Introduction – II

- Problem if the documents are written in less-learned languages:
  - only a few or no human translators are available, security issues
  - no economic interest in building translation systems
- New deployments or new languages for intelligence purposes: How the military system can react agile to this language problem?
- This paper: Propose a concept to improve this situation:
  1. Reducing the expectations of the quality of the translation and
  2. using the approach of *statistical* machine translation (SMT) to rapidly produce new translation system

1. Introduction – III

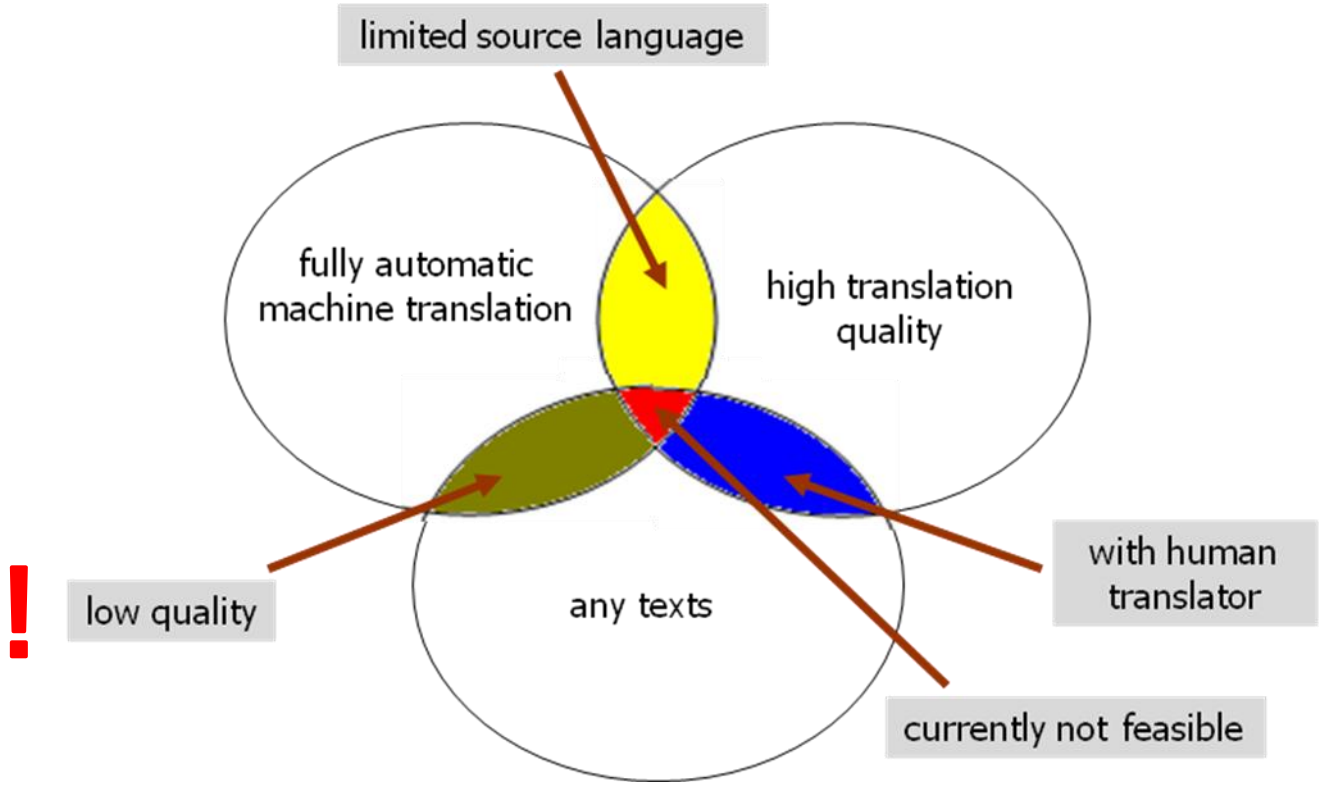
- Gisting: Possible to rapidly construct SMT systems if rough translations are sufficient .
- Gisting:
  - to understand the general content or
  - identify those documents which should be translated by human translators.
- As an example, we describe how we used this approach to set up an SMT system for the language pair Dari – German.

2. Rough translation – I

- Machine translation (MT) is the complete automatic translation of text from one natural (source) language to another (target language) while preserving the meaning.
- Not: Computer-aided translation used by humans (translation memories).
- Gisting: rough translation, not a high quality translation, possible wrong translated words, grammar errors etc.

2. Rough translation – II

- Different types of translation



The graphic is from the talk “Machine Translation II” given by Harold Somers, School of CS, University of Manchester.

2. Rough translation – III

- For new mission-relevant languages any text written in this language might be of interest. Therefore, we have to accept the low quality of the translation.
- According to previous slide this is doable by fully automatic machine translation systems.
- But, if we want to adapt agile to new “language-situations” this is only possible if the systems for fully automatic translations can be constructed rapidly.

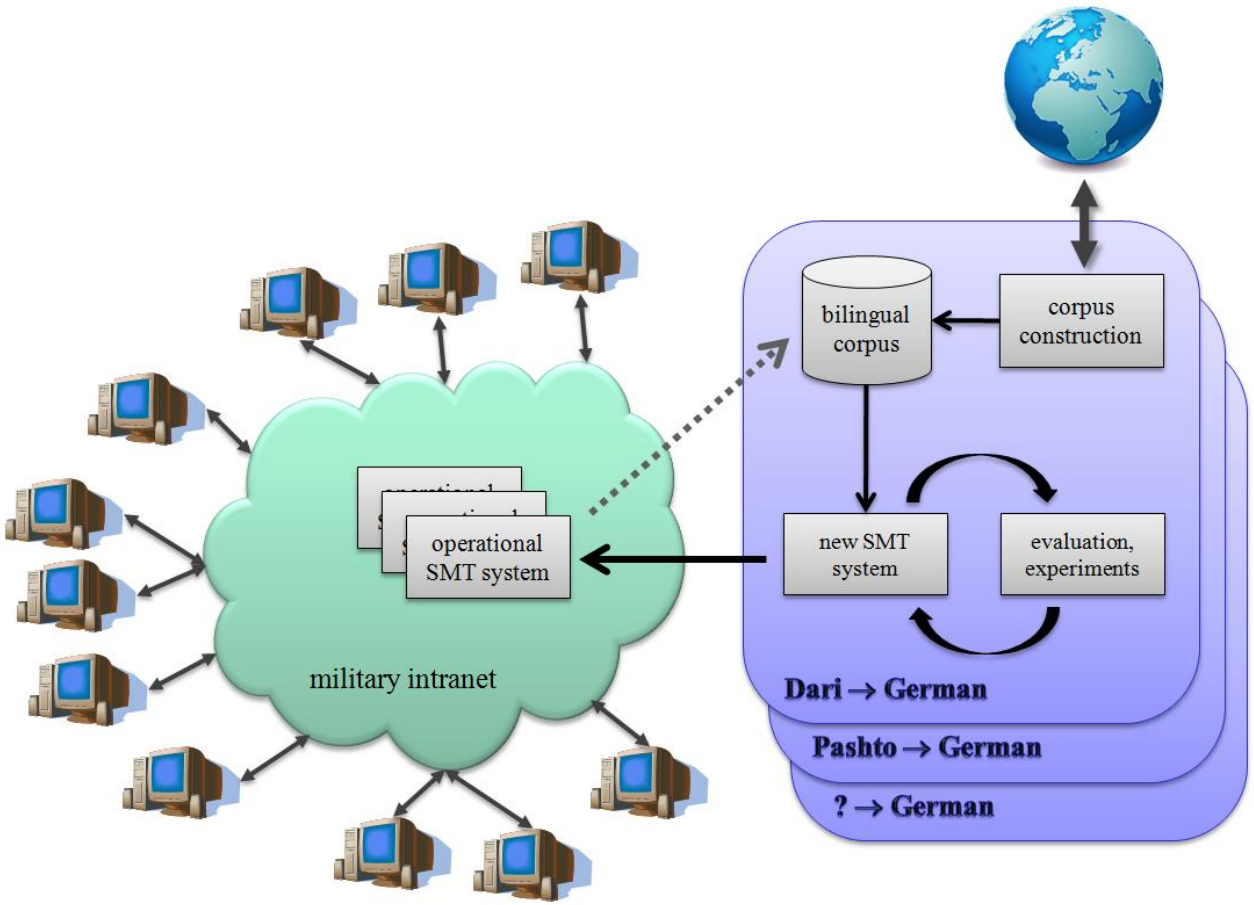
2. Rough translation – IV

- Example for rough translation systems:
  - Forward Area Language Converter (FALCon, U.S. Army Research Laboratory)
    - notebook-based
    - documents are scanned, OCR (optical character recognition)
    - translated into English
    - English text can be searched for keywords
    - used during the Haiti (1995) and the Bosnia (1997) mission

3. Concept for the realization of translation systems – I

- Parts of the (simple) concept:
  1. Reduce the expectations concerning the quality of the automatic translation to rough translation.
  2. Use the approach of statistical machine translation (SMT) to come up very fast with a new translation system.
  3. Build up a team of scientists who are up-to-date to the SMT technology and to the corresponding scientific field and who are responsible to create very fast new versions of the translation system.
  4. Create an military operational centralized automatic translation service for the military users via any military intranet.
  5. Make sure that the operational staff tightly works together with the team of scientists.

3. Concept for the realization of translation systems – II



4. Dari – German as an example - I

- SMT is crucial for the success of the concept.
- We build up a small infrastructure (small team of scientists, computer cluster, procedures, software …) to show that we can come up (fast) with a new SMT system for a language pair relevant for the Bundeswehr.
- Project: Machine Translation for ISAF Forces (ISAF-MT):
  - Objectives: Build up bilingual corpora and linguistic tools and to construct through SMT technology Dari – German translation systems
  - German – U.S. cooperation project (Air Force Research Laboratory, Dari – English)
- Our project proved that a translation system can be produced rapidly (depending of the availability of corpora).

4. Dari – German as an example - II

- Dari
  - spoken by approx. 22 million Afghans
  - spoken in the center and in the northern part of Afghanistan
  - an Indo-European language
  - 28 Arabic characters + 4 additional
  - a right-to-left language, no distinction between uppercase and lowercase, no written short vowels
  - syntactic word order SOV (subject-object-verb)
  - closely related to the modern Iranian Persian (Farsi) and Tajik spoken in Tajikistan

4. Dari – German as an example - III

- Statistical machine translation (SMT)
  - goal: find the "most likely" (best) translation for a given source language sentence
  - for the source language sentence f the target language sentence e is selected that maximizes the probability *p(e|f)*

$$\arg\max_e p(e|f) = \arg\max_e \frac{p(e)\,p(f|e)}{p(f)}$$

  - translation model p(f|e): retains the content of the source language sentence, bilingual parallel corpora
  - language model p(e): the target language sentence is well-formed, monolingual corpus

4. Dari – German as an example - IV

- Excerpt from the ISAF-MT translation model

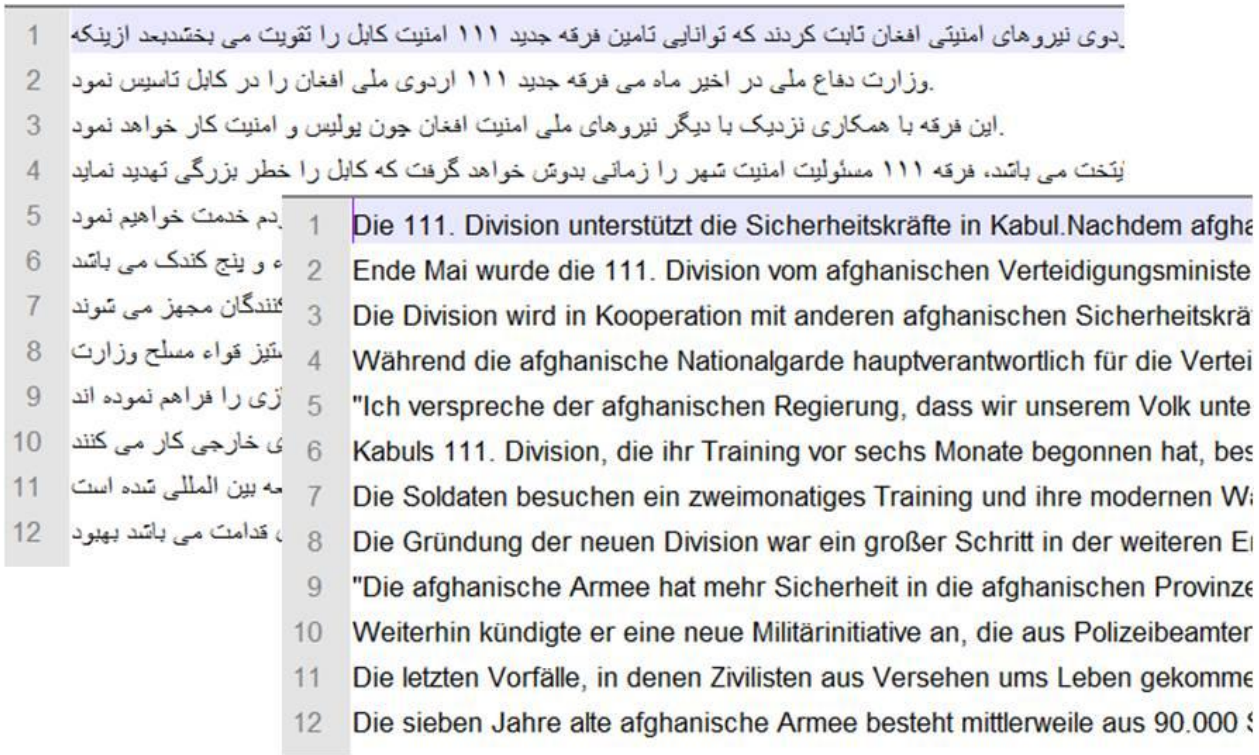
154229	، ساکت باشید ! ||| , sei still ! ||| 0.197548 0.00202913 0.197548 0.00328463 ||| ||| 1 1
154230	، ساکت باشید ||| , sei still ||| 0.197548 0.00331125 0.197548 0.00420655 ||| ||| 1 1
154231	، سایت Welt . online درمطلبی با عنوان می نویسد : ||| Quelle Welt online am 20. Oktober 2008 : ||| 0.0282211
154232	، سایت Welt . online درمطلبی با عنوان می نویسد ||| Quelle Welt online am 20. Oktober 2008 ||| 0.0282211 4.
154233	، سایت های ||| Stationierung von ||| 0.00581022 3.81773e-06 0.0246934 7.41779e-06 ||| ||| 34 8
154234	، سایت های ||| Stationierung ||| 0.00548743 3.81773e-06 0.0246934 0.0006259 ||| ||| 36 8
154235	، سایت های ||| begleitet von der Stationierung von ||| 0.00731657 3.81773e-06 0.0246934 2.60816e-13
154236	، سایت های ||| begleitet von der Stationierung ||| 0.00731657 3.81773e-06 0.0246934 2.20072e-11 ||| ||
154237	، سایت های ||| der Stationierung von ||| 0.00731657 3.81773e-06 0.0246934 4.73274e-07 ||| ||| 27 8
154238	، سایت های ||| der Stationierung ||| 0.00731657 3.81773e-06 0.0246934 3.9934e-05 ||| ||| 27 8

- Excerpt from the ISAF-MT language model

```
-0.9569345 für die Dauer des -0.140566
-0.3309343 für die Dauer von  0.0009403285
-1.329289 nur die Dauer von   -0.006186663
-0.4907208 oder die Dauer der -0.006186663
-0.4907208 und die Dauer der  -0.006186665
-0.4907208 war die Dauer der  -0.2274503
```

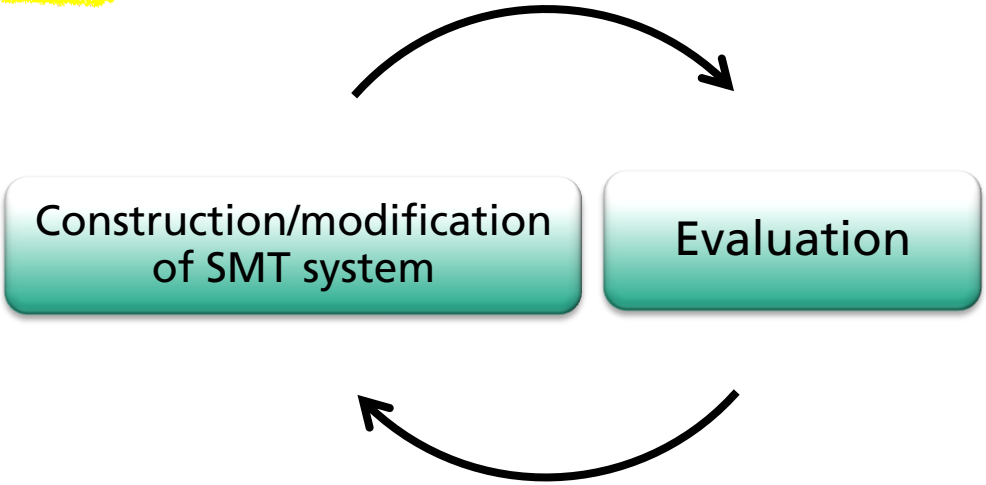
4. Dari – German as an example - V

- The translation model is trained on a bilingual parallel corpus
- Dari – German corpus: topics “military” and “terrorism”; Sada-e-Azadi, Pajhwok, Kokchapress; around 27,000 sentences; military dictionary Dari to German (71,798 entries)



4. Dari – German as an example - VI

- Development of SMT systems: experimental approach, different ways of realizing the translation or language model, different corpus pre-processing, …
- Evaluation is based on a manually checked bilingual corpus (around 1,000 phrases); various metrics, e.g., BLEU, METEOR, TER
- Toolbox: Moses



4. Dari – German as an example - VII

- Overall objective of the experiments: Find improvements of the translation model (and its submodels) and correct weights of the parameter in the models that maximizes the probability of produced translated sentences.
- Considered parameters:
  - size and quality of the tuning set,
  - normalization, compound splitting,
  - reversal of sign and word order,
  - alignment heuristics,
  - maximum phrase length,
  - reordering,
  - inclusion of part-of-speech (POS),
  - inclusion of lemma,
  - inclusion of word stems.

4. Dari – German as an example - VIII

- Experiment: Compound splitting
- The German language has a lot of compound words; words consisting of more than one stem, e.g., “darkroom”
- In this experiment the compounds were split by the Moses Compound Splitter into single words; for both languages

Compound splitting	BLEU	METEOR	TER
baseline	**7,55**	**15,60**	**8,93**
input (dari)	7,14	15,54	9,02
output (deutsch)	6,65	14,98	10,50
input (dari) & output (deutsch)	7,14	15,60	9,02

- Decline in the scores.
- Contrary to the expectation compound splitting does not increase the quality of the translation.

4. Dari – German as an example - IX

- Experiment: Reversal of sign and word order
- Dari has a right-to-left writing system and the verb is located at the end of the sentence.
- In this experiments each line of the Dari side was reversed sign by sign and word by word.

Reversal	BLEU	METEOR	TER
baseline	**11,10**	**16,55**	**8,87**
reverse words	10,03	15,48	9,41
reverse string	10,07	15,50	9,38

- Decline in the scores.
- Simple reversing is not an appropriate way of handling the direction in different writing systems.

4. Dari – German as an example - X

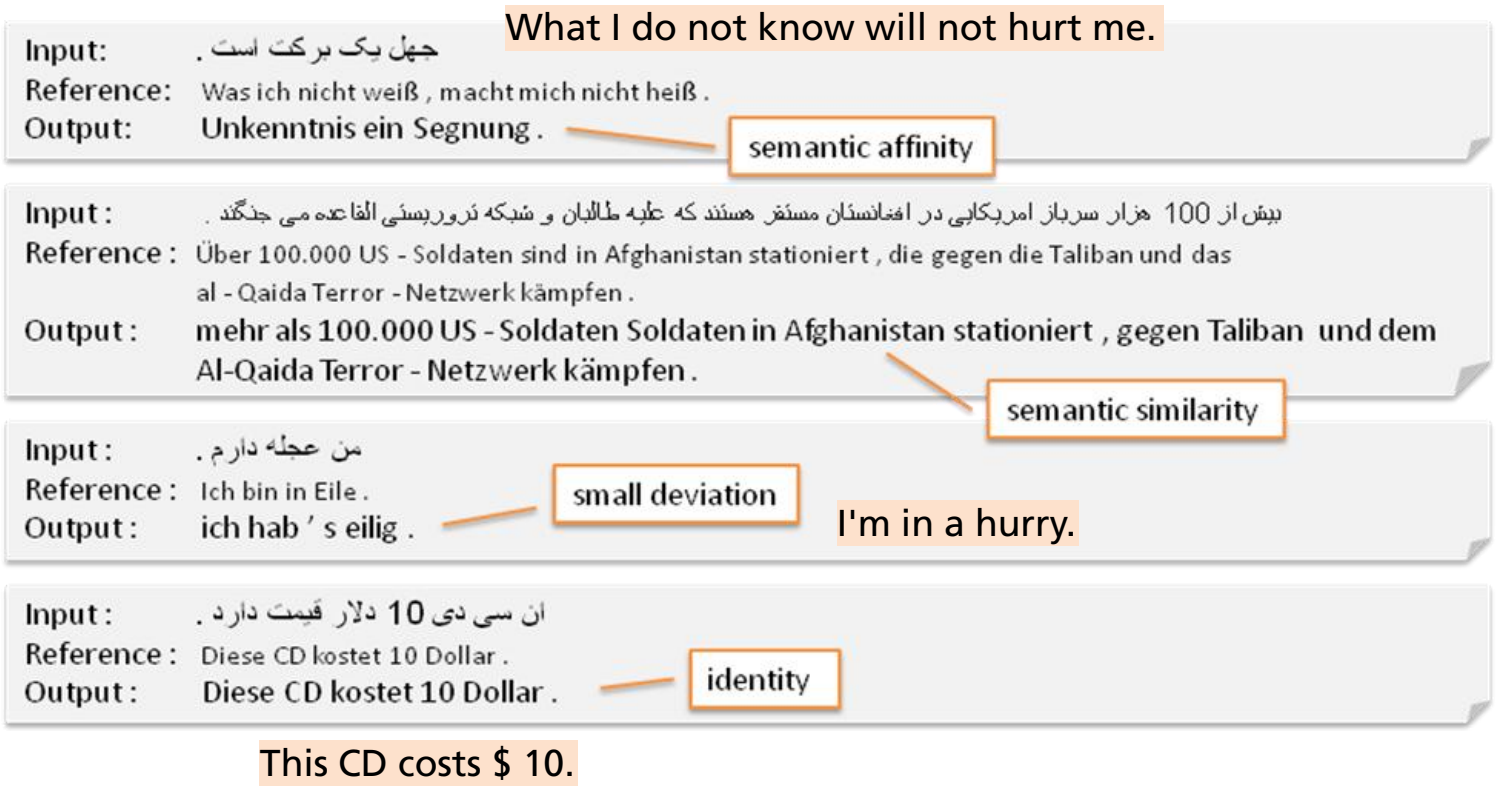
- Experiment: Inclusion of lemma
- Lemmas are abstractions of the various possible word forms, e.g. runs => run, läuft => laufen; integrated by means of factored translation models.
- German: Mate-Tools package; Dari: internal tool.

Inclusion of lemma	BLEU	METEOR	TER
Baseline	**5,34**	**12,14**	**9,11**
align: lemma => lemma	5,77	12,60	9,03
align: word => lemma	5,60	12,14	9,02
align: word + lemma => lemma	5,61	12,23	9,02
trans: lemma => word + lemma	5,37	12,18	9,06
trans: word => word + lemma	5,45	12,18	9,09
trans: word + lemma => word	5,35	12,15	9,08
trans: word + lemma => word + lemma	5,36	12,13	9,09
reord: lemma => word	5,40	12,32	9,07
reord: word + lemma => word	5,42	12,26	9,09

- Alignment can benefit from the inclusion of lemma.

4. Dari – German as an example - XI

- Experiment: Example outputs of the ISAF-MT translation system



5. Conclusion

- Understanding documents written in foreign languages are important in preparation of military operations or during these operations.
- Less-learned language are a problem.
- To overcome the unsatisfying situation we propose a concept:
  - Reduce the expectations for the quality of the translation.
  - Use SMT to rapidly produce new translation systems.
- As an example of using the SMT technology we show a translation system for the language pair Dari – German.
- We report about the corpus construction and the experiments to improve the translation system.
- We were successful in realizing an SMT system of a language pair relevant for the needs of the Bundeswehr. We were able to do this in a couple of month.

5. References

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Thank you for your attention!

Questions?