A gépi fordítás minősége és javítási lehetőségei

The Quality of Machine Translation and the Possibilities of its Improvement

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PhD disszertációjának tézisei

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1. The aims of the dissertation

„A gépi fordítás hasznos? Ez megéri hogy dolgozzon ezen? Ez megéri hogy használja azt?" Many, who have never encountered machine translation, and face it suddenly , or if they intend to use in instead of human translation, ask these questions: is it even worth it to use it? Is it worth it to work on it? When is it going to be like human translation? Machine translated sentences are not perfect, they are hard to read and understand. However, we can often find out their meaning with some effort, and with some work we can even transform them into „human" form. Understanding raw machine translation requires effort and time. This new „language" has to be learnt, and since not everyone is willing to invest this much energy into it, the opinions about the usefulness of machine translation vary. Is it worth it then to work on its improvement if we cannot hope that it will ever be like human translation.

We answer this question with "yes", as there are certain situation when machine translation is useful, and it is worth it to improve it to achieve more and more understandable texts. But how can its quality be improved? How can its quality and it improvement be measured? What does the quality of machine translation mean?

Despite its usefulness and relatively high degree of understandability, readers have negative emotions concerning machine translation, since these texts are considerably different from what we expect and we are used to. But the language use of a speaker of a foreign language is also unusual, many times incorrect, sometimes not understandable and it shows similarities to machine translation. Mártonyi and Varga proved that machine translation and language learners' translation is very similar from the point of view of cohesive devices (Mártonyi és Varga 2007: 80-89). But people tend to be more tolerant and accepting towards such speakers, and they are willing to put effort in understanding if the message is important.

Is machine translation used for the right purposes? Can the attitude be changed, and can machine translation be more acceptable? If the machine translated

texts are understandable can linguistically "strange", unusual, incorrect structures be accepted? Will the degree of acceptability be higher if the text quality increases? What is the connection between understandability and acceptability? In this dissertation we look for the answers to these questions.

2. Theses

The theses of the dissertation are the following:

Thesis 1. The two very important aspects of quality of machine translation, acceptability and understandability are connected but they are not the same or interchangeable. We state that the acceptability of Hungarian machine translated texts is considerably lower than what their understandability would indicate.

Thesis 2. We state that acceptability is a subjective criterion, and it is influenced by several factors. But it can still be measured in an objective way by using sufficient amount of samples. For the objective measuring of acceptability an automatic measuring method has been created.

3. The first quality aspect of machine translation is acceptability. On the one hand acceptability is above all other aspects of quality. If the text is not acceptable, none of the other aspects are relevant. The texts examined in the current research are more understandable that it had been expected, but in order to profit from this understandability, acceptability also needs to be increased. On the other hand acceptability depends on other aspects of quality. Acceptability can be increased in two ways:

Thesis 3.1. If the text is post-edited: the errors are corrected, ie. the text is minimally post-edited, by which their understandability increases by a higher degree than their acceptability.

Thesis 3.2. If the attitude of the readers is changed. We state that relevance theory explains the process of machine translation, as relevance can be increased by changing the attitude of the readers, so that they will be willing to make more effort

to receive the message. Translation studies have a major role in changing the readers' attitude.

4. The analysis of machine translated texts is necessary in order to define post-editing guidelines and rules. Two ways of analysis have been chosen, and two levels of post-editing have been defined.

Thesis 4.1. Machine translated texts contain many errors without a doubt. These errors can be grouped, and their gravity can be determined by their degree of hindering understandability. In order to categorize these errors human translation error categories are not sufficient. After categorizing and ordering machine translation errors and after correcting the most serious ones the understandability of the texts improves in a high degree, and it will be near the level of understanding of human translations. This correction will be called absolutely minimal post-editing.

Thesis 4.2. In order to achieve a stricter, minimal post-editing further error categories can be created if the readers correct the texts, and after the corrections patterns will be extracted. Based on the patterns and errors minimal post-editing rules and principles will be established.

3. The structure of the dissertation

The dissertation consists of 9 chapters. Chapter 1 introduces the aims of the dissertation and the research questions. Chapter 2 is about the basics of machine translation, and its position in translation studies. It shows that relevance theory is suitable to explain the process of machine translation, and gives suggestions on the role of translation studies in determining the role and position of machine translation. Chapter 3 describes the aspects and measuring methods of machine translation quality. It emphasizes that the main aspects of MT quality are accuracy/fidelity, fluency/readability, understandability and acceptability. (Fiederer and O'Brien 2009: 54-56, Arnold 1994: 158-160, Hutchins et al. 1992: 163, Boitet 1988: 2, Callison-Burch et al. 2008: 72, Koehn és Monz 2006: 105, Gamon et al. 2005: 104).

Chapter 4 concentrates on understandability. It presents the research carried out to measure understandability and the understandability index that has been created. It compares the subjective degree of acceptability with the understandability index. Chapter 5 presents the automatic measuring method for the objective measurement of acceptability. The chapter also deals with the shortcomings of the METEOR metrics according to (Banerjee és Lavie 2005: 67, Denkowski és Lavie 2010: 106), and also suggest a better solution. The chapter presents a new greedy algorithm that has been necessary to solve the problem. Chapter 6 descirbes the possibilities of improving machine translation, and also discusses the question whether it is more worthwhile to use human translation instead of post-edited machine translation. The chapter also presents the possibilities of automatic post-editing.

Chapter 7 is about the research carried out to study the errors of English–Hungarian machine translation, after which the categories and principles for absolutely minimal post-editing have been created. It presents the automatic method that extracts the editing operations between raw machine translation and post-edited machine translation, and the results of using the method: the further rules, principles and correction patterns. Chapter 8 connects the studies about understandabilty and acceptability, and shows the effects of post-edition on acceptability. Chapter 9 summarizes the results and suggests further directions for research.

4. The method of the research

4.1. Comparing subjective acceptability and understandability

In order to compare understandability and acceptability a questionnaire was used. The questionnaire consisted of three English–Hungarian machine translated texts with questions on their content, and also questions about the subjective opinion of the readers. The subjects also had to explain certain parts of the texts. 72 people filled in the questionnaires. To verify the results further questionnaires were used, with one text each, 6 altogether. Each of these 6 questionnaires were filled in by 30.

4.2. Objective measurement of acceptability

In order to be able to measure acceptability objectively, a new method has been created. 10 text pairs (about 1500 characters each) were used to tune and test the method with countless runs.

4.3. Determining the principles for minimal post-editing

To determine the errors of machine translation and the principles of the absolutely minimal post-editing the results of the above mentioned questionnaire was used. For the further error analysis and for the minimal post-editing principles a Hungarian–Hungarian parallel corpus consisting of 58 text-pairs (about 1500 characters each) was used. A program has been made to analyse the texts and to extract the post-editing operations between the raw machine translations and their post-edited versions. The edit operations were further analyzed manually.

4.4. Comparing the acceptability of raw and post-edited machine translation

In order to compare the acceptability of raw and post-edited machine translation with the automatic method a part of the Hungarian–Hungarian parallel corpus was used, 29 text-pairs altogether.

5. Results

5.1. The quality of machine translated texts – understandability and acceptability (Thesis 1)

The quality of machine translation is made up of several factors that are presented by Estrella (Estrella 2008: 1) according to the FEMTI evaluation framework. In this dissertation understandability and acceptability have been chosen from the internal factors. According to Boitet et al. (Boitet et al. 2009: 3-4) and their C x Q x A meta-theorem, the production of coverage, quality and automaticity will always be considerably below 100%, but the production of two of these factors can reach this value, if we are willing to sacrifice from the third factor. Consequently the quality of fully automatic, not domain-restricted, online accessible machine translation cannot

be perfect. In order to improve quality evaluation can be done manually or automatically. Some of the most well-known automatic metrics are the BLEU (Papineni et al. 2002: 311-318), the NIST (Doddington et al. 2002: 128-132), the METEOR (Banjeree és Lavie 2005: 67-70) and the (H)TER (Snover 2006: 223-231). These methods measure the similarity between machine translation and human translation, ie. accuracy and fluency, and acceptability indirectly. But measuring understandability should be done manually.

In order to evaluate the understandability of English–Hungarian machine translation a questionnaire was made (Chapter 4). From the results an understandability index was created with the values in the interval of [–1;+1]. Values in the interval of [-1;0[indicate the level of misunderstanding, and values in the interval of [0;1] indicate how much understandable the text is. This index can be applied to evaluate machine translated and post-edited texts, and to compare these with human translations. The results show that the understandability of machine translated texts is 0.414, and that of human translations is 0.974. The index of 0.414 is 28% lower than the understandability of human texts, but can still be considered good understandability in the interval of [–1;+1].

But in spite of these results 72% of the readers found machine translation unacceptable. This indicates that understandability and acceptability are not equal categories, and they are not directly proportional, even though this would be the desired case in order that machine translation can be useful.

5.2. The objective evaluation of acceptability (Thesis 2)

A text has to be acceptable for it to be considered a text (Beaugrande 1983: 4). In our opinion this criterion is enough for the readers to view a translation as text, and afterwards to decide how useful it is to them according to the other six criteria. Acceptability is a subjective criterion, as it depends on the internal and external circumstances of the reader apart from the text quality, thus its objective evaluation is very difficult. For this reason an automatic evaluation metric has been created that

is based on an assumption of Amigó et al. (Amigó et al. 2006: 22-23), that the more a machine translated text is similar to a human text, the more acceptable it is.

This new evaluation method (Chapter 5) evaluates the texts with an index in the interval of [0;1] by using the Hungarian texts on the internet as a reference corpus. This method is an objective evaluation method of a very subjective aspect of quality. According to the tests, and also to the results of the human evaluation, it has been proven that the method is useful and reliable. It meets the requirements given in (Hovy et al. 2002) that an automatic evaluation method needs to meet. The result has a lower and upper limit: 0 and 1. 0 means the worst possible quality, that has been proven with the tests with "bad" texts. The requirement of monotonicity has been proven with comparing the results with human judgment. The Spearman correlation coefficient between human judgment and the automatic evaluation method is a very high 0.96.

The method also has its disadvantages, one is that the evaluation of texts to be compared has to be done in a short period of time, because the content on the internet changes constantly. The other disadvantage is that the software itself has to be modified if the websites of the search engines change.

An added result of the research was that a new fragmentation penalty measure was found instead of the present measure of the METEOR evaluation method. In order to test this measure a new, greedy algorithm was created to find the optimal coverage of an interval (Chapter 5.6).

5.3. Increasing acceptability

5.3.1. Minimal post-editing (Thesis 3.2)

Gósy says that according to psycholinguistic researches readers accept it more willingly if they have difficulties understanding a sentence than grammatical errors. Therefore if the errors in the text are created the texts are expected to become more acceptable and understandable. A questionnaire has also been made from the minimally post-edited texts to measure understandabilty and acceptability.

According to the results readers have a better opinion of the minimally post-edited texts than of raw machine translation. In the first questionnaire 72% had a negative opinion about raw machine translation, and 34% had some kind of a negative opinion about post-edited machine translation. After measuring understandability it has been proven that the texts are more understandable than what would be expected from the results of acceptability and what readers themselves judge. According to the automatic evaluation it can be seen that acceptability increases with post-editing, but understandability increases even in a higher degree.

Text	Acceptability	Acceptability index	Understandability index [0;1]
Raw machine translation	0.358	0.414	0.707
Absolutely minimally post-edited MT	0.391	0.869	0.934
Minimally post-edited MT	0.524	-	-
Full post-edited MT/human translation	0.872	0.974	0.987

5.3.2. **Machine translation and translation studies**

Thesis 3.1

Despite machine translation not being like human translation, and even though it does not replace human translation, it can still be used in several situations. Its usefulness is proven by examples (Chandioux 1976: 27-36), and since many machine translation systems are freely available online, instead of complete rejection it is more important to emphasize what it can be used for. Raw machine translation is useful in the following situations:

a) When human resources are not enough.

b) When there is a need for fast and low-cost translation.

c) There are certain situation and functions where machine translation is perfect, whereas human translation is not, eg. consistent use of terminology, spelling (Sager 1994: 265).

d) Between similar languages (Kis 2008: 15).

e) To gain information (Newton 1992: 4).

Machine translatable texts need to have certain characteristics that are given in (Sager 1994: 292, Hutchins 2005: 5), and we also add that they have to be informative texts.

If machine translation is under the scope of translation studies, a general theory is needed that is able to explain the process of machine translation. In the dissertation it has been shown that the relevance theory can be such a theory. The difference between human and machine translation lies in the "person" of the translator, however, the relevance theory (Gutt 2000: 24-58) explains the complete process of machine translation. The relevance theory also supports that machine translation is useful (Heltai 2005: 46), and it gives reasons for the shortcomings of its quality.

Because of the readers' expectations, their ignorance concerning machine translation and the artificial language the acceptability of machine translated texts does not reflect their quality. If machine translation is used in situations and for texts that it is not suitable for, this generates further negative opinions and the spreading of bad quality translations. Therefore translation studies have a very important role to avoid these negative consequences and to clarify the position of machine translation.

5.4. Defining post-editing principles

5.4.1. Absolutely minimal post-editing (Thesis 4.1)

A general problem of post-editing is that there are no principles that would define the levels of post-editing and the necessary corrections (Allen 2001: 26-27, Allen and Hogan 2000: 65). Post-editing can be done in two or three stages: brief and full post-editing, and (Allen és Hogan 2000: 65) also mention minimal post-editing. The current aim is to give a guideline for minimal post-editing, and to measure the understandability and acceptability of minimally post-edited texts. Within minimal post-editing absolutely minimal post-editing has also been defined, in which only the most serious errors have to be corrected.

Previously we have presented a survey that measures the understandability of machine translation. With the help of this survey detailed error categories have been created, and also a correction index that assigns gravity to the errors (chapter 7.1). The gravity is determined according to how much the error affects understandability. The correction index is in [-5;+5]. The order of errors help to define the minimal post-editing guidelines, and these errors are also later compared to the results of the post-editing operations made by readers. The requirement of absolutely minimal post-editing is that the errors with negative correction index have to be corrected. The error categories and the order of errors show that in spite of the number and gravity of errors the seemingly completely unacceptable and incomprehensible texts are understandable in a higher degree than expected.

The average understandability index of absolutely minimally post-edited texts is 0.869 (chapter 8), which means that if only the gravest errors are corrected the understandability of machine translation increases significantly: it is only slightly less than the average understandability index of human translation, which is 0.974. The understandability index of raw machine translation was 0.414, which is considerably under both values.

It can be seen that post-editing is worthwhile, since it highly improves understandability while the time spent on minimal post-editing is only a fraction of the time spent on human translation.

5.4.2. **Principles, rules and patterns for minimal post-editing (Thesis 4.2)**

In order to define the categories for absolutely minimal post-editing only a very few texts were used. After the analysis of further texts it has been proven that the list of errors gives a suitable starting point for post-editing, but further errors still need to be corrected. Further error categories were added to the list, and it has been defined which of these are necessary to be corrected and which of them can be judged by the post-editor.

A program has been implemented to help the analysis that collects the post-editing operations (deletion, insertion, move, substitution). The software was made according to the modified Levenshtein algorithm (Navarro 2001: 35) suggested by Kis (Kis 2008: 78-81). The parallel corpus made up by raw machine translation and their minimally post-edited versions was analyzed by the program. After the analysis further rules and post-editing patterns have been defined. The aim at defining these rules and patterns was to make the texts understandable and more acceptable.

6. Summary

The study gives original and new ideas in the following:

- It separates the acceptability of machine translation from its understanability.
- It gives a new, objective and automatic method to evaluate acceptability.
- It suggests a new, modified fragmentation penalty for the METEOR automatic metric.
- It offers a new, low-cost algorithm to find the optimal coverage of an interval from the point of view of the fragmentation penalty.
- It gives specific post-editing suggestions for the post-editing of English–Hungarian machine translated text translated by MetaMorpho.

The restrictions of the research and the possibilities of further improvement:

- The software evaluating the acceptability can only be used for Hungarian texts.
- Only texts from one single machine translation system were used. The automatic method measuring acceptability can be used for any kind of text, and the software extracting the post-editing operations can also be applied for texts translated by any systems or even for human translation, thus these research results can be generalized in further analyses.
- The size of the corpus used is very small compared to corpora used in natural language processing. The software made for the extraction of post-editing

operations can be used for a larger sized parallel corpora to define further specific patterns and rules.

- The possibilities of automatic post-editing has not been examined, but this would be the most significant step forward. It is worth it to examine the possibilities of automatic post-editing with the help of the principles, rules and patterns.

7. References

Allen, J. 2001. Post-Editing: An Integrated Part of a Translation Software Program. In: *Language International*. Vol. 13. No. 2. 26-29.

Allen, J., C. Hogan: 2000. Toward the Development of a Post-Editing Module for Raw Machine Translation Output: A Controlled Language Perspective. In *Proceedings of the Third International Workshop on Controlled Language Applications*. Seattle, WA. 62-71.

Amigó, E., Giménez, J., Gonzalo, J., Màrquez, L. 2006. MT evaluation: human-like vs. human acceptable. In: *Annual Meeting of the ACL Proceedings of the COLING/ACL on Main conference poster sessions*. Sydney, Australia. 17-24.

Arnold, D.J., Balkan, L., Meijer, S., Humphreys, R.L., Sadler, L. 1994. *Machine Translation: an Introductory Guide*. London: Blackwells-NCC.

Banerjee, S., Lavie, A. 2005. METEOR: An Automatic Metric for MT Evaluation with Improved Correlation with Human Judgments. In: *Proceedings of Workshop on Intrinsic and Extrinsic Evaluation Measures for MT and/or Summarization at the 43rd Annual Meeting of the Association of Computational Linguistics (ACL-2005)*. Ann Arbor, Michigan, USA. 65-72.

Beaugrande, R-A. de, and Dressler, W. U. 1981. *Introduction to text linguistics*. London: Longman.

Boitet, C. 1988. Bernard Vauqois' contribution to the theory and practice of building MT systems: a historical perspective. In: *Second International Conference on Theoretical and Methodological Issues in Machine Translation of Natural Languages*. Carnegie Mellon University, Center for Machine Translation. Pittsburgh, Pennsylvania, USA. 1-18.

Boitet, C., Blanchon, H., Seligman, M., Bellynck, V. 2009. Evolution of MT with the Web. In: *Proceedings of the Conference "Machine Translation 25 Years On"*. Cranfield, England. 1-13.

Callison-Burch, C., Fordyce, C., Koehn, P., Monz, C., Schroeder, J. 2008. Further meta-evaluation of machine translation. In: *ACL-08: HLT. Third Workshop on*

Statistical Machine Translation, Proceedings. (ACL WMT-08). The Ohio State University, Columbus, Ohio, USA. 70-106.

Chandioux, J. 1976. METEO, an operational system for the translation of public weather forecasts. In: *FBIS Seminar on Machine Translation. American Journal of Computational Linguistics.* 27-36.

Denkowski, M., Lavie, A. 2010. Extending the METEOR machine translation evaluation metric to the phrase level. In: *NAACL HLT 2010: Human Language Technologies: the 2010 annual conference of the North American Chapter of the Association for Computational Linguistics. Proceedings.* Los Angeles, California. 250-253.

Doddington, G., 2002. Automatic Evaluation of Machine Translation Quality using N-gram Cooccurrence Statistics. In: *Proceedings of 2nd Human Language Technologies Conference (HLT-02).* San Diego, CA. 128–132.

Estrella, P., Popescu-Belis, A., King, M. 2008. Improving quality models for MT evaluation based on evaluators' feedback. *LREC 2008: 6th Language Resources and Evaluation Conference.* Marrakech, Morocco.

Fiederer, R., O'Brien, S. 2009. Quality and machine translation: a realistic objective? *Journal of Specialised Translation. Vol. 4.* London. 52-74.

Gamon, M., Aue, A., Smets, M. 2005. Sentence-level MT evaluation without reference translations: beyond language modeling. In: *10th EAMT conference "Practical applications of machine translation".* Budapest. 103-111.

Gósy, M. 2005. *Pszicholingvisztika.* Budapest: Osiris.

Gutt, E. A. 2000. *Translation and relevance: Cognition and context.* Manchester: St. Jerome Publishing.

Heltai P. 2005. A fordító és a nyelvi norma II. *Magyar Nyelvőr.* 129. évf. 1. szám 30-58.

Hovy, E., King, M., Popescu-Belis, A. 2002. An introduction to MT evaluation. In: *LREC-2002: Third International Conference on Language Resources and Evaluation. Workshop: Machine translation evaluation: human evaluators meet automated metrics.* Las Palmas, Canary Islands. 1-7

Hutchins, J. 2005a. Current commercial machine translation systems and computer-based translation tools: system types and their uses. *International Journal of Translation.* Vol.17. No. 1-2. 5-38.

Hutchins, J., Somers, H. 1992. *An Introduction to Machine Translation.* London: Academic Press Limited.

Kis B. 2008. A fordítástechnológia és az alkalmazott nyelvtudomány. (Kiadatlan doktori értekezés.) Pécs: Pécsi Tudományegyetem.

Koehn, P., Monz, C. 2006. Manual and Automatic Evaluation of Machine Translation between European Languages. In: *Proceedings of the Workshop on Statistical Machine Translation*, 102–121.

Mártonyi É., Varga Á., 2007. Learners' translation – machine translation. Lexical cohesion in language learners' and machine translation. Lendvai E. (szerk.) 2007. *Translatologica Pannonica. A PTE BTK Fordításudományi Kutatóközpont elektronikus folyóirata.* I. évf. 1. szám. Pécs: PTE BTK. 80-89.

Navarro, G. 2001. A guided tour to approximate string matching. *ACM Computing Surveys.* Vol. 33, No. 1. 31-88.

Newton, J. 1992. Introduction and overview. In: Newton, J. (ed.) 1992. *Computers in Translation: A Practical Appraisal.* London: Routledge. 1-13.

Papineni, K., Roukos, S., Ward, T., and Zhu, W. J. 2002. BLEU: a method for automatic evaluation of machine translation. In: *ACL-2002: 40th Annual meeting of the Association for Computational Linguistics.* 311–318.

Sager, J. C. 1994. *Language Engineering and Translation: Consequences of automation.* Amsterdam: John Benjamins.

Snover, M., Dorr, B., Schwartz, R., Micciulla, L., Makhoul, J. 2006. A study of translation edit rate with targeted human annotation. In: *AMTA 2006: Proceedings of the 7th Conference of the Association for Machine Translation in the Americas, "Visions for the Future of Machine Translation".* Cambridge, Massachusetts, USA. 223-231.

8. Publications related to the dissertation

8.1. Publications

Varga Á. 2006. Understanding Machine Translation. In: Chroust, G., Hoyer, C. (eds.) *Schriftenreihe Informatik Vol. 19.* Linz: Trauner Verlag Universität. 285-297.

Varga Á. 2007. Géppel fordított szövegek hibái. In: Heltai P. (szerk.) *Nyelvi modernizáció.* A XVI. Magyar Alkalmazott Nyelvészeti Kongresszus előadásai. 721-727.

Varga Á. 2007. An Internet-based Method for Machine Translation Evaluation. Chroust, G., Hoyer, C. (eds.) 2007. *Schriftenreihe Informatik Vol. 22.* Linz: Trauner Verlag. 321-333.

Varga Á., Mártonyi É. 2007. Learners' translation – machine translation. Lexical cohesion in language learners' and machine translation. In: Lendvai E. (szerk.) *Translatologica Pannonica.* A PTE BTK Fordításudományi Kutatóközpont elektronikus folyóirata. I. évf. 1. szám Pécs: PTE BTK. 80-89. http://translat.btk.pte.hu/downloads/translat/translat_2007_nov.pdf

Varga Á. 2009. Géppel fordított szövegek értékelése az internet segítségével. In: Nádor O. (szerk.) *A magyar mint európai és világnyelv.* A XVIII. Magyar Alkalmazott Nyelvészeti Kongresszus előadásai. Budapest. 847-859.

Varga, Á. 2010. Machine Translation: Can it be a way of communication in a workgroup? Chroust, G., Doucek, P., Oskdral, V. (eds.) *Schriftenreihe Informatik Vol. 32.* Linz: Trauner Verlag. 387-395.

Varga Á. 2010. Utószerkesztési és értékelési módszerek a gépi (és az emberi) fordítás javítására. In: Zimányi Á. (szerk.) *Alkalmazott nyelvészeti kutatások a magyar nyelv évében.* A XIX. Magyar Alkalmazott Nyelvészeti Kongresszus előadásai. Vol. 6. Eger: MANYE. 847-859.

8.2. Conference presentations

Varga Á. 2006. *Géppel fordított szövegek hibái.* Elhangzott: XVI. Magyar alkalmazott nyelvészeti kongresszus. Szent István Egyetem, Gödöllő 2006. április 10-12.

Varga Á. 2006. *Understanding Machine Translation.* Elhangzott: IDIMT-2006 14th Interdisciplinary Information Management Talks, Ceske Budejovice, Csehország. 2006. szeptember.

Varga Á., Mártonyi É. 2006. *Gépi fordítás - tanfordítás.* Elhangzott: Kultúrák dialógusa a soknyelvű Európában III. Pécs. 2006. november 24-25.

Varga Á. 2007. *Géppel fordított szöveg: magyar vagy nem magyar? Választ adhat az internet?* Elhangzott: Magyar Fordítók és Tolmácsok napja – IV. PhD konferencia. Budapest. 2007. március 29-30.

Varga Á. 2007. *An Internet-based Method for Machine Translation Evaluation.* Elhangzott: IDIMT-2007 15th Interdisciplinary Information Management Talks, Ceske Budejovice, Csehország. 2007. szeptember.

Varga Á. 2008. *Géppel fordított szövegek értékelése az internet segítségével.* Elhangzott: XVIII. Magyar alkalmazott nyelvészeti kongresszus. Balassi Bálint Intézet, Budapest 2008. április 3-5.

Varga Á. 2009. *Utószerkesztési és értékelési módszerek a gépi (és az emberi) fordítás javítására.* Elhangzott: XIX. Magyar alkalmazott nyelvészeti kongresszus. Eszterházy Károly Főiskola, Eger. 2009. április 16-18.

9. Publications not related to the dissertation

Varga Á., Hatwágner M. 2005. Összetett oktatási információs rendszer. In: *SZÁMOKT.* Kolozsvár. 44-54.

Hatwágner M., Varga Á. 2005. Oktatást és adminisztrációt segítő információs rendszer In: *Informatika a felsőoktatásban 2005.* 262.

Benyó B., Hatwágner F. M., Heckenast T., Kovács K., Varga Á., Varjasi N. 2005. Enum eljárásra alapuló szolgáltatások megvalósítása. In: *Informatika a felsőoktatásban 2005.* 158.

Benyó B., Hatwágner F. M., Heckenast T., Kovács K., Varga Á., Varjasi N. 2005 Novel Communication Services Based on ENUM Technology In: *INES 2005*, 9th IEEE International Conference on Intelligent Engineering Systems.

Varga Á., Benyó B., Hatwágner F., Heckenast T., Kovács K., Varjasi N. 2006. Design and Implementation of Enum-Based Services. *Journal of Universal Computer Science.* Vol. 12. Nr. 9. 1128-1138.

Varga Á., Sziray, J. (jegyzet) 2006. *Szakértői rendszerek*. Elektronikus jegyzet (HEFOP-3.3.1.P.-2004-09-0102/1.0). 1-151.