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Some issues on Italian to LIS automatic translation. The case of train announcements

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Abstract

English. In this paper we present some linguistic issues of an automatic translator from Italian to Italian Sign Language (LIS) and how we addressed them.

Italiano. *In questo lavoro presentiamo alcune questioni linguistiche inerenti la traduzione automatica da Italiano a lingua dei segni italiana (LIS).*

1 Introduction

Computational linguistic community showed a growing interest toward sign languages. Several projects of automatic translation into signed languages (SLs) recently started and avatar technology is becoming more and more popular as a tool for implementing automatic translation into SLs (Bangham et al. 2000, Zhao et al. 2000, Huenerfauth 2006, Morrissey et al. 2007, Su and Wu 2009). Current projects investigate relatively small domains in which avatars may perform decently, like post office announcements (Cox et al., 2002), weather forecasting (Verlinden et al., 2002), the jurisprudence of prayer (Almasoud and Al-Khalifa, 2011), driver's license renewal (San-Segundo et al., 2012), and train announcements (e.g. Braffort et al. 2010, Ebling/Volk 2013).

LIS4ALL is a project of automatic translation into LIS where we faced the domain of public transportation announcements. Specifically, we are developing a system of automatic translations of train station announcements from spoken Italian into LIS. The project is the prosecution of ATLAS, a project of automatic translation into LIS of weather forecasting (http://www.atlas.polito.it/index.php/en). In ATLAS two distinct approaches to automatic translation have been adopted, interlingua rule-based translation and statistical translation (Mazzei et al. 2013, Tiotto et al., 2010, Hutchins and Somer 1992). Both approaches have advantages and drawbacks in the specific context of automatic translation into SL. The statistical approach provides greater robustness while the symbolic approaches is more precise in the final results. A preliminary evaluation of the systems developed for ATLAS showed that both approaches have similar results. However, the symbolic approach we implemented produces the structure of the sentence in the target language. This information is used for the automatic allocation of the signs in the signing space for LIS (Mazzei et al. 2013), an aspect not yet implemented in current statistical approaches.

LIS4ALL only uses the symbolic (rule-based) translation architecture to process the Italian input and generate the final LIS string. With respect to ATLAS, two main innovations characterize this project: new linguistic issues are addressed; the translation architecture is partially modified.

As for the linguistic issues: we are enlarging the types of syntactic constructions covered by the avatar and we are increasing the electronic lexicon built for ATLAS (around 2350 signs) by adding new signs (around 120) specific to the railway domain. Indeed, this latter was one of the most challenging aspects of the project especially when the domain of train stations is addressed. Prima facie this issue would look like a special case of proper names, something that should be easily addressed by generating specific signs (basically one for every station). However, the solution is not as simple as it seems. Indeed, several problematic aspects are hidden when looking at the linguistic situation of names in LIS (and more generally in SL). As for the translation architecture, while in ATLAS a real interlingua translation with a deep parser and a FoL meaning representation were used, in LIS4ALL, we decided to employ a regular-expression-based analyzer that produces a simple (non recursive) filler/slot based semantic to parse the Italian input. This is so, because in the train announcement domain, input sentences have a large number of complex noun phrases with several prepo-

sitional phrases, resulting in a degraded parser performance (due to multiple attachment options). Moreover, the domain of application is extremely regular since the announcements are generated by predefined paths (RFI, 2011).
The rest of the paper is organized as follows: Section 2 discusses the linguistic issues, Section 3 discusses the technical issues while Section 4 concludes the paper.

2 Linguistic Issues

The domain of application consists of the messages broadcasted in Italian train stations. Rete Ferroviaria Italiana (RFI) produced a manual, called MAS (Manuale degli Annunci Sonori), that describes the details of each specific message (RFI, 2011). MAS specifies 39 templates that RFI uses to automatically produce the messages: 15 templates deal with leaving trains (A1,..., A15), 13 templates with arriving trains (P1, ..., P13), while 11 messages with special situations (e.g. strikes, R1, ..., R13). The templates have been designed to produce concise and direct messages in Italian. Full relative clauses, coordination and complex structures (e.g. ellipses) are avoided. As a consequence, the domain is that of a controlled language. In Fig. 1 there is a fragment of the template A1, that concerns the leaving of a train without additional information on (in time or place) changes in the schedule.

Figure 1. A fragment of the A1 template (RFI, 2011).

The template includes fixed parts (e.g. “IL TRENO”), variables (e.g. “CATEGORIA” “NUMERO”) and optional parts (e.g. “IN RITARDO”). By analyzing a corpus of 24 hours messages produced at the Torino Porta Nuova Station (5014 messages total) we found that a small number of templates covers the majority of announcements while others are virtually absent (Table 1).

#messages	Template Name	%
1818	A1	36.26
1310	P1	26.13
685	A2	13.66
431	A3	8.60
52	P9	1.04
48	P5	0.96
19	A5	0.38
2	P13	0.04
649	*other templates*	12.94
TOT. 5014		

Table 1. The templates occurrences in 24 hours of Torino Porta Nuova station messages.

2.1 An Italian-LIS parallel corpus

In order to have a minimal but significant bilingual corpus Italian-LIS, we chose a subset of 7 sentences, which have been translated in LIS by a Deaf[1] native signer, supervised by the help of a professional LIS interpreter and a Sign Language linguistics researcher.
Focusing on the nominal domain a number of differences between Italian and LIS emerged. To mention one, consider the quite simplified subject in (1) and its LIS counterpart in (2):
(1) Il treno per Susa …
'the train to Susa … '
(2) TRAIN SUSA GO …
'The train going to Susa'
While the Italian NP is modified by a prepositional phrase, the LIS NP is modified by what we analyzed as a reduced relative clause.
At the clausal level, the syntactic complexity of the subjects in the input language forced the introduction of a pronominal pointing that we analyzed as a resumptive subject clitic, a phenomenon completely absent from Italian.

2.2 The issue of station names

Another crucial linguistic issue concerns the best way to translate the names of the stations in LIS. Indeed, the linguistic situation of names is quite heterogeneous and can be summarized as follows: (1) Sign names fully acknowledged by the Italian Deaf communities; (2) Sign names only acknowledged by (part of) the local Deaf community; (3) There is no sign name even within the local community.

[1]Capital “D” is used to refer to deaf people who are signers and part of the signing community as opposed to people who simply suffer of an acoustic deficit.

The first option illustrates the case of most main stations in big cities. Normally, the name of the station is semantically transparent, as in "Milano centrale", or it involves the name of some prominent character of the Italian history, as in the case of "Milano Porta Garibaldi". However, most of the trains go to and stop at obscure locations. In some cases, local dialects have a specific sign for those stations (normally, the name of the town where the train stops) as in the station of "Castelvetrano". Finally, there are Italian names for which not even the local Deaf community has already developed a local sign name. In those cases, human signers adopt the last resorts at their disposal, namely either they fingerspell the name, or they use mouthing, as in the case of "Rebaudengo Fossata", a very small station in Turin.

Fingerspelling is the typical way in which borrowings from spoken languages are realized (Brentari 2000). However, this practice is not fully adopted by the Italian Deaf communities yet. Indeed, old signers may not know the manual alphabet and in some cases they even refuse to use it, rather preferring the mouthing of word in spoken Italian (Volterra 1987 and Caselli et al. 1996).

Once we leave the domain of human signers and enter the world of signing avatar, additional issues are raised which are specifically connected to fingerspelling and mouthing. Clearly, mouthing is a solution that cannot be usefully pursued for practical reasons: The avatar technology is designed to be portable on different devices including smartphones. Within this framework, lipreading would be almost impossible for most users of the service. Furthermore, working in the domain of public transportation announcements, the timing issue is not trivial. Announcements are normally broadcasted and fingerspelling would introduce additional delay to the sign production, which normally is more time consuming than speech.

After having preliminarily consulted some members of the local Deaf Association of the city where the automatic translation system will be first released (ENS Torino), a twofold solution is going to be adopted: 1. Sign names fully acknowledged by the Italian Deaf communities will be maintained by the signing avatar; 2. Blended written Italian-LIS sign forms will be used (Geraci and Mazzei, 2014).

While names of main stations in big cities are preserved in their original LIS forms, as in Fig. 2., a new strategy is developed for less-familiar stations and gaps in the vocabulary. The avatar will play a classifier sign indicating a wide board while the name of the station will appear in written Italian "centered on the board", as shown in Fig. 3.

Figure 2. Animation for "Milano Centrale"

Figure 3. Animation for "Rebaudengo Fossata"

This technical solution blends a manual sign (a generic classifier) with a non-manual component. However, rather than using the standard non-manual channels (facial expressions or body postures), this solution adopts a tool which is not internal to sign language, namely the written form of the dominant language. From the communicative perspective, this solution is much more performative than standard fingerspelling for at least three reasons: 1. It allows a faster assessment of the lexical item since the written input is produced simultaneously and not letter by letter; 2. It does not overload the processing of the entire sentence; 3. It is accessible to all signers, even those with lower levels of literacy. From the timing perspective, blended forms are much quicker to perform than fingerspelling making the entire announcement more alignable with its spoken counterpart. The decision of implementing two separate strategies for train station names rather than extending the blending strategy to all station names has been made after having preliminary consulted our linguistic informants. However, we are planning to assess a broader part of the Deaf community on this specific issue.

3 Technical Issues

Figure 4 illustrates the pipeline of the current architecture and includes five modules: (1) a regular expression parser for Italian; (2) a filler/slot based semantic interpreter; (3) a generator; (4) a spatial planner; (5) an avatar that performs the synthesis of the sequence of signs, i.e. the final LIS sentence. Note that we had access to the MAS manual but we did not have access to the technology used to generate announcements in the station. So, we could not use any additional information, apart from the message, for the translation.

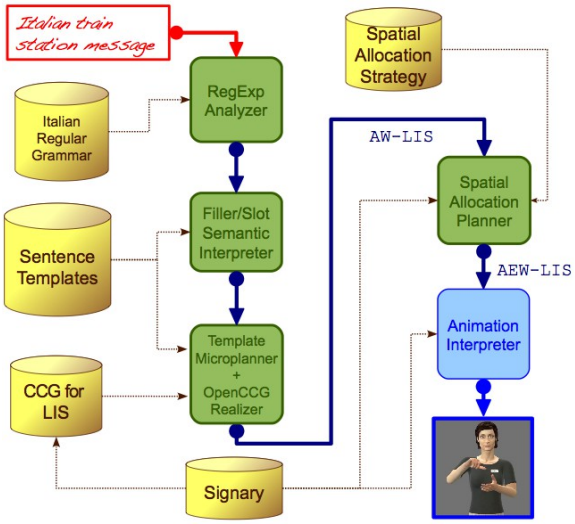

Figure 4: LIS4ALL translation architecture

By using the MAS, we built 8 regular expressions corresponding to the 8 most frequent templates found in our corpus (see Table 1). For each template, we designed a sequence of semantic slots that are filled by lexical items (time, rail, station names, etc.) contained in a specific message. Each singular slot corresponds to a singular variable of the message template (see Fig. 1), that is filled by a domain lexical element (e.g. “milano centrale” or “straordinario”). We plan to cover the remaining templates by the end of the project.

The LIS4ALL generator is composed by two submodules: a microplanner and a realizer (Reiter and Dale, 2000). The microplanner decides about the syntactic organization of the sentences and about which signs to use in the generation. Following Foster and White (2004), we implemented a template based microplanner that is able to exploit the filler/slot structure produced by the semantic analyzer. The output of the microplanner is a hybrid logic formula in a tree-structure (XML), that encodes an abstract syntactic tree. Extending the CCG grammar (Steedman, 2000) designed in the ATLAS (Mazzei 2012), and using the parallel corpus Italian-LIS produced in LIS4ALL, we implemented a new CCG grammar for LIS that can be used by the OpenCCG realizer to produce LIS sentences in the railway domain (White 2006). Finally, the spatial planner accounts for the signs positions in the space by using the same strategy used for ATLAS (this module of the architecture is still in progress.).

In order to implement our solution for stations names we implemented a double access procedure to the signing lexicon in the generator. In a first attempt, the microplanner will search in the lexicon for a direct translation of an Italian station name into LIS (see above "Milano centrale"). If at least one translation is found, then the avatar follows the standard ATLAS communication pipeline and performs the (sequence of) sign(s). If this procedure does not produce results, for instance, when there is a lexical gap in the LIS dictionary for the station name, the microplanner and the realizer command the avatar to produce the Italian-LIS blending for that specific station name in real time. So, we augmented the avatar to allow for the production of a real time Italian-LIS blending from a string (up to 40 characters). Finally, we augmented the communication protocol between SentenceDesigner and the avatar, by adding a new tag <SIGNBOARD> to the AEWLIS (ATLAS Extended Written LIS), i.e. to the XML language in use for the communication between the generator and the avatar.

4 Conclusions

In this paper we considered two issues related to the development of an automatic translator from Italian to LIS in the railway domain. These are: 1) some syntactic mismatches between input and target languages; and 2) how to deal with lexical gaps due to unknown train station names. The first issue emerged in the creation of a parallel Italian-LIS corpus: the specificity of the domain allowed us to use a naive parser based on regular expressions, a semantic interpreter based on filler/slot semantics, a small CCG in generation. The second issue has been addressed by blending written text into a special “sign”. In the next future we plan to quantitatively evaluate our translator.

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