The Current State of Machine Translation

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Abstract

This paper aims to survey the current state of research, development and use of Machine Translation (MT). Under 'research' the role of linguistics is discussed, and contrasted with research in 'analogy-based' MT. The range of languages covered by MT systems is discussed, and the lack of development for minority languages noted. The new research area of spoken language translation (SLT) is reviewed, with some major differences between SLT and text MT described. Under 'use and users' we discuss tools for users: Translation Memory, bilingual concordances and software to help checking for mistranslations. The use of MT on the World Wide Web is also discussed, regarding pre- and post-editing, the impact of 'controlled language' is reviewed, and finally a proposal is made that MT users can revise the input text in the light of errors that the system makes, thus 'post-editing the source text'.

1. Introduction

> Predictions in the MT field have in the past been notorious for excessive optimism or for disillusioned pessimism. The safest prediction is that there will be a long-term future for nearly all varieties of systems. Machine aids, workstations, and interactive MT will be preferred by professional translators. Post-edited MT will continue in large translation services and in translation bureaux. Restricted input MT will remain the option for some multinational companies, unless 'raw' MT output improves greatly. Unrevised MT ... will be adopted increasingly for information-only translations. Automatic telephone translation seems unlikely in the near future, but universal access on demand via public networks to many different kinds of automatic translation facilities ... does not now seem to be in the least Utopian. (Hutchins, 1987:52)

With these words, John Hutchins brought to a close his preview of MT research at the first MT Summit, ten years ago. His predictions about the use of 'standard' MT services have been borne out. As we shall see below, his view of automatic telephone translation seems to have been a little pessimistic. But his suggestion that universal access via public networks seems to me to have been the most prescient of all: in 1987 the Internet was largely an academic e-mail network, and the size and scale of the World Wide Web was barely imagined at that time.

Predicting the future is always a pretty tricky business; in this paper it is my aim only to 'predict' the present. But this too has become fairly difficult in our field. There was a time when it was realistic to expect to be able to attend more or less all the MT-dedicated conferences and workshops without access to a huge travel budget: they were certainly spread over the globe, but one could reckon on one, or at most two such meetings a year, at which one could expect to meet a subset of more or less the same 50 or 100 people. In addition, the literature on MT was fairly restricted, relevant articles, which appeared in journals dedicated to neighbouring or contributory fields like computational linguistics, translation studies, human-computer interfaces, software engineering, were infrequent enough that one could easily keep abreast of everything. And most significantly, if there were any commercial products to speak of, their appearance was heralded with a great clamour in MT circles. In short, with MT as one's chosen specialist subject, one could be fairly confident of knowing pretty well what was going on all the time.

This all contrasts with the situation nowadays. Commercial MT and translation-related products abound. Although there is still active research in the field (which we shall discuss below), the marketplace is where most of the action is, with new products appearing, modes of use and evaluation the issues. We have a variety of annual and biannual meetings, including *MT Summit,* exhibitions that take much more than 10 minutes to visit, dedicated

journals, newsletters and magazines, and a world-wide community of many thousands of people if we include — as we must — users (past and present) of MT software.

In the remainder of this paper, I will make the distinction between 'research' and 'use and users'. Under the heading of 'research' we will discuss the kind of work which is pushing at the frontiers of knowledge in the MT domain and which will not be seen in the marketplace for a few years yet (notice how suddenly one is wary of guessing in public what the lead time is from research lab to software distributor!): notably here we will discuss spoken language translation systems; but we will also mention the wave of activity in the 'new' paradigm of analogy-based MT. Under 'use and users', we will draw attention to the shifting patterns of use of MT systems, especially the emergence of a broader range of tools for translators, the use of MT for casual users, notably on the Web, and finally some ideas about getting the best out of currently available software, including what I think is a new proposal, which I call 'post-editing the source text' *(sic)*.

2. Research

In this overview of current MT research, we will make the distinction between linguistics-based research and work in the (now not so) new paradigm of corpus-based (analogy-based, example-based) MT; we will briefly mention an area of special interest to this author: MT for 'second class' languages; and we will focus on research into spoken language translation.

2.1. Linguistic approaches

Basic research in MT — at least to judge by the submissions to conferences such as AMTA (last held in Montreal in 1996) and TMI (the most recent was held this summer in Santa Fe) — still focuses on the 'hard' problems. It is true to say that what counts as a hard problem might depend on the approach taken, but the translation of structurally divergent constructions ('head-switching', lexical gaps), temporal and modal expressions, and problems requiring contextual or real-world knowledge (anaphora, lexical selection) continue to interest researchers. Essentially linguistic approaches are still just as popular as the more 'empirical' approaches which first appeared in force at TMI 92, also in Montreal. Older theoretical issues like the transfer-interlingua debate seem passé now, while the once lively empirical vs. rationalist debate seems to have been overtaken by an overwhelming acceptance of 'hybrid' approaches.

One problem with linguistic approaches to MT research is the difficulty of scaling up a prototype into a commercial product. Although commercial systems *are* influenced by ideas from basic research much more than they were at first, and — as we shall see below — there are now a number of systems which have completed the cycle from basic research prototype to commercial product, it is still the case that the interest of researchers is in solving rather narrow problems while remaining faithful to an ideological approach, and there is a certain conflict between this aim and the more global aim of producing a working system, in which an engineering rather than theoretical approach often takes priority.

Translation remains an excellent test-bed for theoretical computational linguistics, but experience of the last 20 years should warn us that the major task in developing an MT system that works is still the elaboration of lexical resources rather than linguistic rule systems.

Nevertheless, a shift in emphasis in terms of what MT systems are used for has caused a number of interesting problems into the limelight. While the recognition of the impossibility of fully automatic high-quality translation of unrestricted texts let MT researchers 'off the hook' to a certain extent, the sudden interest in using MT to get rough translations, in particular in the context of the World Wide Web and translation of e-mail, has put a number of topics back on the agenda.

Among these is the intriguing problem of recognising and dealing with proper names (e.g. Gallippi 1996, Yoshimura et al. 1997). In the case of translation between languages using different scripts, this might involve transliteration which, as Knight & Graehl (1997) show, is not a trivial matter. A similar problem, in that it involves recognition and so often leads to the prevention of translation, is the fact that Web pages and e-mails often mix languages or contain literal strings (such as URLs or e-mail addresses) which should not be translated. This is not dissimilar to the problem, in document translation, of recognising figures and tables.

2.2. Analogy-based MT

At the beginning of this decade, an apparently new paradigm for MT research began to emerge, crystallizing at the TMI Conference in Montreal in 1992. The paradigm is characterized by the preference of data-oriented models of language, derived by statistical or analogical methods, as opposed to rule-based models derived from linguists' intuition. Rather quickly however, hybrid approaches have emerged, in essentially one of three forms:

- rule-based systems where the rules are derived more or less automatically from data;
- analogy-based systems where the examples are generalized so as to take on the form of rules;
- true hybrid systems, where the alternative approaches work alongside.

The first of the alternatives mentioned above is now almost universally embraced: with the availability of machine-readable dictionaries as well as multilingual corpora, many researchers are turning their attention to the extraction of linguistic knowledge, for use in rule-based systems, from these resources. There is of course discussion and debate about the limitations of this process (cf. Church 1996, Wilks 1996), but at the very least, most MT research system developers will work from a reference corpus which defines the range of vocabulary and structures their system will cover.

The second approach has been reported for example by Furuse & Iida (1992) and further developed in the same authors' 1994 and 1996 papers. The basic idea is to try to discover what the rule underlying similar examples is, and thereby infer linguistic rules on this basis. This is an interesting hybrid, because it is data-driven, but rule-like in application, and in theory should benefit from the advantages of both approaches.

The best example of the third approach is in the PANGLOSS system reported by Frederking & Nirenburg (1994), Frederking et al. (1994), and Brown & Frederking (1995), in which three quite different methodologies are applied in parallel, with a top-level monitor attempting to reconcile the different results. In PANGLOSS, the three approaches used almost epitomize the three extremes of MT system design: a knowledge-based system, an example-based system, and a rule-based lexical transfer system.

2.3. Languages covered

One thing to notice is that MT research has still not significantly ventured much beyond the major world languages, perhaps for obvious economic reasons. As ever, political as well as economic considerations are a force in certain (geographical) locations, no better illustrated than in work on DIPLOMAT, a speech translation system for which English is paired with Serbo-Croatian, Haitian Creole and Korean (Frederking et al. 1997). Older readers will remember that researchers at Logos worked on Vietnamese and then Farsi (Persian) before they settled on German. The influence of the funders is obvious here. Certainly within the European Union, less dominant languages such as Dutch, Danish and Portuguese have received attention, but it is still the 'big five' (French, German, Italian, Spanish, Japanese) that are targeted, and almost always paired with English. Systems handling Russian, Chinese, Korean and Arabic are only just beginning to appear in listings of commercially available systems[1]. It is also interesting to note that the majority of systems are developed as bilingual systems, and although the development of a new language pairing might be 'piggy-backed' on the back of an existing system, truly multilingual systems are still very much a rarity.

There is still a big gap though in development of products (not just MT, but MT-related, and computer aids for translators) for minority languages, particularly NIMLs (non-indigenous minority languages): these are of sociological perhaps more than economic importance; and a further problem might be that the particular languages needed differ from region to region, depending on patterns of migration. In the European context, these are languages of the Indian subcontinent, certain far east Asian languages such as Cambodian and Vietnamese, Turkish, Persian, Maltese, and languages of the former Communist bloc, including Yugoslavia. For North America there will be some overlap with this list, but the priorities may be different. This is a topic that I address in more detail in Somers (forthcoming).

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1. For example, the *World Language Resources* software guide often distributed with the magazine *Multilingual Communication & Technology,* that magazine's own advertising section, or lists like Miller (1995), an updated version of which is being prepared at the moment.

2.4. Spoken language translation

Perhaps the most significant new area for MT research is that of spoken language translation (SLT). As we saw at the beginning of this article, for a long time it was assumed that this task was simply too difficult. However, speech processing has come on in such leaps and bounds that there are now a significant number of research projects in this area.

It might be thought that SLT was simply a matter of coupling a speech-to-text front-end and a text-to-speech back-end to a conventional text MT system, but this approach would be completely inadequate for all but the most formal types of spoken language. Interestingly, the field is dominated by one sort of SLT system, aimed at translating dialogues, and more particularly what Kay et al. (1994:175) have identified as "cooperative" dialogues, for example between a traveller and a travel agent, where the dialogue partners collaborate towards a common goal, as opposed to "adversarial" dialogues, e.g. between business persons negotiating a contract. The implications of this apparently minor distinction are quite enormous, especially in terms of interpreting the pragmatic aspects of the dialogue. Other distinctions that might impinge on the design of an SLT system include

- whether it is face-to-face or telephonic;
- whether it has the possibility of interactive disambiguation and/or confirmation, and if so ...
- whether this also is speech-based (introducing the difficulty of identifying system-user "metadialogue", cf. Somers et al. 1990) or on a separate user interface (cf. Frederking et al. 1997);
- whether users are purely monolingual or may switch languages from time to time (cf. Fung et al. 1997).

Almost all the SLT literature focuses on dialogue translation, with very little work as yet reported on what might be termed, by analogy with MT, Machine Interpretation, that is, simultaneous or consecutive translation of spoken language in the context of a meeting or a person addressing a group of people. Interestingly, this might prove to be a somewhat less difficult task than dialogue translation, apart from the exigencies of real-time processing of course, since the type of language that gets interpreted (by human interpreters) is usually much more formal than everyday dialogue, and closer in nature to the written language.

Another application that does not yet seem to have attracted much attention is the SLT corollary of e-mail translation, namely 'voice-mail', where there is also scope for translation. The problems would be similar to those involved in translation of other spoken messages, for example between emergency or security services across linguistic borders, e.g. in the Channel Tunnel.

While there are interesting research areas in the speech-processing aspects of SLT, the main interest, as with text MT, lies in handling the linguistic problems, which are many and various, and have only a small overlap with those encountered in text MT. Among the problems particular to SLT are

- identifying and processing spoken language phenomena such as hesitations and self-repairs — some of these are performance errors, but others actually serve a subconscious pragmatic function (cf. Horiguchi 1997);
- correctly interpreting speech act phenomena and discourse functions;
- dealing with different accents, and mixed-language speech (cf. Fung et al. 1997);
- much greater use of anaphora and ellipsis;
- ill-formed utterances, or rather, varied grammaticality of spoken language.

Space does not permit further exploration if these interesting topics, but one can be sure that they will feature prominently in the MT literature in the next few years.

3. Use and Users

Let us turn now away from the research side of MT to its public face, and the use by real users of commercial products. Ten years ago it was a reasonable expectation that an interested observer would be more or less familiar with, and perhaps have a copy of, all the MT and MT-related products on the market. This is now far from possible: apart from the prohibitive cost of obtaining all available software, the variety of languages covered, and computational platforms served, would make it a questionable ambition.

In recent years we have seen a huge proliferation of software with a broad range of functions, languages covered and, of course, prices. It seems that Sager's (1986) prediction that MT would soon offer "a choice to the customer, varying from the cheap and nasty of the dime store to the Tiffany or Carrier of translation" has come about, except that the "cheap" are not necessarily "nasty". The reason for this is that awareness of the proper

way to use MT has increased greatly, so while it is true that generally "you gets what you pays for", customers generally also know that they should analyze their needs before deciding what to get.

From a personal point of view, it is perhaps most gratifying to see that after all the 'second generation' approach can provide the basis of some commercial systems, with a number of commercially available products developed from what started out as essentially research systems. Nevertheless, I still suspect that the development from research lab prototype running on a large workstation (or even mainframe) to marketable product running on a PC owes more to software engineering than to computational linguistics, and it is fair to say that the grammars and rule-bases inside the systems would still look fairly unfamiliar to a linguistics major (cf. for example Gdaniec & Schmid, 1995).

3.1. Tools for users

One of the most important changes of focus over the last few years has been the renewal of interest in developing sophisticated tools for translators. Ideas about what such tools should look like remained fairly static for a long period: if we look at Martin Kay's (1980) blueprint[2] for a Translator's Workstation, we can see the model for almost all MT and translation-related products to be developed over the next 15 years. Only with the emergence of statistical and corpus-based research methods have some really innovative ideas been added to that early design (cf. Isabelle & Church 1997).

3.1.1. Translation Memory. Perhaps the most pervasive of the 'new' translator's tools is the 'Translation Memory' (TM), though in fact this idea is far from recent. The first use of the term itself is somewhat difficult to track down, but it seems to have come into use at about the same time, confusingly, as the idea of 'memory-based translation' (an alternative name for example-based MT, mentioned above), although the two concepts are only marginally related. But the idea to use past translations as a reference predates the term by a long way: in Kay (1980) there is a hint of the idea: "... the translator might start by issuing a command causing the system to display anything in the store that might be relevant to [the text to be translated].... Before going on, he can examine past and future fragments of text that contain similar material" (Kay 1980:19), and a fairly limited implementation of the idea, then called "Repetitions Processing", was available from the mid-1980s in ALPS, one of the first commercially available MT systems (Sibley 1988, Weaver 1988).

3.1.2. Bilingual concordances. With the availability of large bilingual corpora, and especially alignment algorithms to process them, it is now possible to incorporate in the Translator's Workbench this tool which is related to the TM, but whose purpose is to search for previous translations of a given word or phrase as a reference for the translator, rather than whole sentences to be pasted in to the target text. Again, the idea for such a tool can be found in earlier literature: Kjaersgaard (1987) makes such a proposal, but is unclear how to implement it, while Harris's (1988) notion of "bi-text" is clearly relevant. The CITI group (now moved to Université de Montréal) have developed an impressive implementation of this idea based on the Canadian Hansard corpus (Isabelle et al. 1993).

3.1.3. Checking for mistranslations. In a similar fashion, tools which help the translator check for translation errors are now appearing. Macklovitch (1994) describes a tool, again based on aligned parallel corpora, that can check for "deceptive cognates" *(faux amis)* like *library!librairie,* and also for caiques (e.g. **certificat de naissance* for *birth certificate).*[3] Another problem for translators is inconsistent translations of the same or similar pieces of text. As Merkel (1996) describes, although TM is useful for preventing this, there is the problem of detecting inconsistencies after they have been made. And a further tool for the translator based on parallel text alignment techniques is described by Melamed (1996), who shows how it may be possible to detect portions of text that have been omitted.

3.2. MT on the Web

One of the most interesting developments in the last few years is one which somewhat goes against the grain of MT use: while members of the MT community have been persuading the general public of the limitations of MT software, and carefully nurturing the kind of awareness that prevents disappointment when users actually get

2. A similar idea was also proposed by Erhard Lippmann in 1971, and is of course hinted at in vague terms in the ALPAC report, cf. Hutchins (1996).

3. We use the traditional linguistic notation of prefixing an asterisk to indicate an ungrammatical string.

hold of MT software, there has emerged a new ballpark for MT use where all these restrictions and limitations are ignored — yet it seems to be the fastest growing area of use for MT. I am referring of course to translation of materials found on the World Wide Web and, to a lesser extent, of e-mails and bulletin-board postings.

Pioneered by CompuServe (Harrison 1992), and demonstrated at the first AMTA meeting in 1994, Flanagan (1996) reported that users are at first "amazed", then disappointed, then pragmatic about the quality of the translations. Translation of this nature is especially difficult, because as a text-type e-mails and postings to bulletin boards are often informal, even ungrammatical (especially regarding punctuation, capitalization and spelling). Yet on-line translation has clearly been accepted as a useful service. In Japan, it is the main reason for purchase of MT software, which now often is included in Internet software packages sold there. The major MT software developers now recognise the opportunity that the Web offers, either marketing software specifically aimed at Web page translation (cf. Nesbitt 1997) or, for example in the case of Systran, making translation of web pages freely available, presumably as a means of promoting their visibility and establishing their credibility as one of the leading MT providers.

3.3. Pre- and post-editing

Let us turn finally to the ages-old question of pre- and post-editing as a means of mitigating the weaknesses of MT systems. It is now well accepted that the input to most MT systems needs to be restricted if the output is to be useful without wholesale post-editing, and traditionally these restrictions have been labelled 'sublanguage' if they occur naturally, and 'controlled language' if they are artificially imposed. It is encouraging to see both these approaches flourishing. For example, Chandioux & Grimaila (1996) report how a version of METEO®, the long-time standard-bearer of sublanguage MT, was developed for use at the Atlanta Olympic Games, while there is a growing community of controlled language users and researchers, many of whom focus on the link between controlled language and MT (e.g. Adriaens 1995, Mitamura & Nyberg 1995, van der Eijck 1996).

I wish to end this article with a brief suggestion of a possibly new working practice for MT users.This is a simple and obvious idea, but one which I have not seen mentioned anywhere else. Until I find a better term, I call it 'Post-editing the source text'.

3.3.1. Post-editing the source text: introduction. There is a traditional view of MT which makes a clear separation between preparation of the source text which the system takes as input ('pre-editing') and revision of the output from the system to provide the target text ('post-editing'). Bearing in mind the way most commercial MT systems currently function, an alternative suggests itself, namely regarding the input to the system as an artifact based on, but essentially independent of the source text as given, and hence available to the MT system user throughout the translation process. In other words, we wish to propose that the activity known as 'post-editing', i.e. revision in the light of errors that the MT system has made, can equally involve adjusting the *input* to the system, and that this might be even more efficient in some cases than post-editing the output: hence the apparently anomalous epithet.

The MT process, as traditionally described, comprises three quite separate stages — pre-editing, translation (which may or may not be interactive), and post-editing — always in that apparently logical sequence; but each requires the user to understand in some sense how the system works, or at least what its limitations and capabilities are. This gives rise to a possible conflict for the user, because it might not always be obvious where is the best place to intervene in order to prevent or correct an error: before it arises (pre-editing), at the suggestion of the system (interaction), or after it has happened (post-editing).

While traditional descriptions of MT give the impression that these three activities are quite distinct and clear-cut, it is apparent that they are not, especially if we suppose the same person is involved at each stage, bringing the same linguistic competence to the task, and with the same background knowledge and understanding of how the system works. The design of a typical currently available commercial MT system does not preclude a more local pre-edit—interaction—post-edit sequence in that the user might work through the text sentence by sentence or paragraph by paragraph. Or indeed the user might prefer a kind of 'mixed' strategy, performing some global pre-edits before focusing on individual portions of text, locally post-editing some errors, and leaving some others for a final global post-edit. Note that this scenario requires that the user know the system really rather well, or at least that they quickly recognize which errors are likely to be repeated throughout the text: these are the errors which should be treated — if possible — with a single global correction. But there is also a case to be made for yet another mode of working within this mixed strategy, which we are calling 'post-editing the source text' *(sic)*.

Several writers have considered the different skills required for post-editing (e.g. Wagner 1985, McElhaney & Vasconcellos 1988), and among them familiarity and comfort using word-processors is obviously important. Vasconcellos (1987) specifically mentions efficiency in cursor positioning, use of search-and-replace, and, particularly, developing an ability to see the best combination of word-processor 'moves' to bring about a change, as skills which are just as important as linguistic knowledge of the relevant languages. For example, it is apparent that working through a text line by line is not the most efficient way to do post-editing in the context of a word-processor: it is better to take a more structured approach to post-editing, in particular with respect to recurring errors, which can be fixed by using global search-and-replaces.

In fact, it is not, unfortunately, quite that simple. The user of search-and-replace has to remember that the requirements of grammar and orthography have to be taken into account, so that a global search-and-replace risks both under- and overshooting. Both can be exemplified by the following: suppose we decide to change throughout the text every occurrence of the word *replace* with the word *renew* (to remove the possible ambiguity with the meaning 'put back'). A global search-and-replace will correctly change *replace* to *renew* and *replaces* to *renews,* but will leave *replaced* as * *renewd,* and will miss *replacing* and *Replace* (with an initial capital), or *re-place* (split over two lines, with a hyphen) altogether. The problem is in a sense even worse if in fact it was *put back* that was the required correction, as we would get **put backs* and **put backd* with this simple manoeuvre. And if the word *irreplaceable* happened to occur in the text, this too would be changed to *irrenewable* or **irput backable.* Obviously, experienced users are aware of these pitfalls, but they do undermine somewhat the advantages of using these word-processor facilities. Computational linguists have occasionally written about the possibility of a "linguistically intelligent word processor" that would be sensitive to such grammatical and orthographic difficulties (e.g. Hutchins & Somers 1992:153), but no such tool has yet been developed.

This brings us to our new proposal for getting the best out of a moderate-quality MT system: in 'post-editing the source text', we wish to propose that the activity known as 'post-editing', i.e. revision *in the light of errors* that the MT system has made, can equally involve adjusting the *input* to the system, and that this might be even more efficient in some cases than post-editing the output. The key point here is that we are combining the possibility of controlling the errors that an MT system produces by manipulating its input, i.e. the source text, with the possibility of reacting to the errors once we have seen them, which is normally thought of as post-editing. The novelty is that we are post-editing the input, not the output. Bearing in mind the typical set-up of a commercial MT system, with source and target text in neighbouring windows, and translation of the whole text or just parts of it more or less at the touch of a button, it should be obvious that text-editing in the source-text window is essentially no more troublesome than text-editing in the target-text window, and so the traditional division between looking at the source text only before the MT system processes it, and confining all post-processing work to the target text is not the only way to do things.

The proposed translation process is now as follows, assuming the original source text to be in a suitable machine-readable form. First, the source text will be prepared in the normal way, if any reformatting is necessary even before the first MT pass. There may also be a stage of 'unknown-word checking' and dictionary update. There may even be pre-editing of the 'conventional' variety. One clear result of this distinction is that there will be three (or four) types of textual artefact associated with the MT process, and we need some distinctive terminology for this: the source text, the input to the MT system, the output from the MT system, and the final completed translation. Furthermore, the cycle of post-editing the input and/or output may be repeated several times.

The key point is that it is up to the user to determine which is easier, editing the input or the output? In the following paragraphs we will give some examples of our proposal at work, which should give some indication of how to determine which strategy is best. Unfortunately there is no easy metric to tell whether fixing the input or output is more efficient; but long-term experience with the particular MT system should help the user get a good idea of the types of errors that respond well to 'post-editing the source text'.

3.3.2. Example 1: *fog* and *mist.* Let us begin with the simple case of a wrong synonym. Suppose we are translating maritime weather forecasts from English into French. In the English the term *fog* is used, which should in this context be translated as *brume* in French. The system dictionary however favours *brouillard* as the translation. Obviously one solution would be to change the dictionary, but since this is a 'one-off' translation, we decide we do not want to do this. Post-editing the target text, changing *brouillard* to *brume* would be straightforward enough, except for the fact that *brouillard* is masculine, *brume* feminine. It is no longer a case of globally replacing *brouillard* with *brume:* we also have to look at each case to see whether any other words in the context need to be changed to show gender agreement. A better strategy is to change the input from *fog* to *mist,* which also translates

as *brume,* and let the system do the gender agreement for us. This first example is not very different from the kind of change proposed in a controlled-language approach. Perhaps even in the context of English maritime weather forecasts, *mist* would have been a more appropriate word to use than *fog*.

3.3.3. Example 2: peeling, stoning and cutting. This next example is a case where a weakness in the MT system's handling of a fairly common construction causes us to make some corrections. This time, we are translating recipes from French into English, and, as is normal in French recipes, the instructions are given using not the imperative but the infinitive form of the verb. Unfortunately, our (not very sophisticated) MT system consistently translates these infinitives — for reasons we can only guess at — into present participles, so we get examples like *peler les pêches → peeling the peaches, dénoyeauter → stoning, couper les fruits en quartiers→ cutting the fruits into quarters,* where the simple imperatives *peel, stone* and *cut* would have been preferable. So we are faced with the task of changing the present participles into plain imperative forms. But notice that, because of the rules of English morphology, we cannot simply search through the output text deleting the *-ing* endings, as this would give us **ston* and **cutt* besides the correct form *peel.* A better solution is to change the forms in the input text to imperatives which, for the most part, can be done by changing the final *-er* to an *-ez.* The resulting text is equally grammatical and understandable in French. But more important, it gives a correct translation in English.

3.3.4. Example 3: *bigger* — *biggest.* In the next example, we found that the MT system was unable to distinguish correctly comparative and superlative adjectives in French when preceded by an article. For example, the phrase *une plus grande intégration économique* would translate as **a biggest economic integration.* Correcting this error in the target text would often be a case of changing the *-est* ending to *-er,* but in some cases the comparative and superlative are formed with the words *more* and *most,* so these must be searched for too. Searching for and deleting the articles in the input text is more efficient. One thing to note about this example, unlike the previous two, is that the changes make the input text something less than good French. We will see this to an even greater extent in the next two examples

3.3.5. Example 4: the France, the Japan, and other nations. In a text about marketing, which we translated from English into French, we found that our MT system was not very good at correctly inserting definite articles before the names of countries, as they are required in French. Like adjectives in the earlier example, definite articles are susceptible both to gender and number agreement (e.g. *le Japon, la France, les États Unis),* but also form portmanteau forms with certain prepositions (e.g. *à + le → au, de + les → des).* So again it was a simpler matter to go through the English input text changing *France* to **the France* and so on, in which case the correct form of the definite article appeared in the target text.

3.3.6. Example 5: Pie to the apples. A major source of errors for a low-range MT system like ours is the too literal translation of prepositions. Again, because of portmanteau forms like *au, des* etc., it is more efficient to change the prepositions in the input text, to assure a more correct translation. So we change *loaded with* to **loaded of* to generate *chargé de(s), on the sheltered slopes* is changed to **at the sheltered slopes* to give *aux pentes à l'abri,* and so on. In the other direction, attempting to translate recipes, we found that deleting the preposition *aux* in phrases like *tarte aux pommes* gave the correct translation *apple pie* rather than ** pie to the apples.* In terms of effort, there is not much difference between deleting *aux* from the input compared to deleting *to the* from the output, except that a global search-and-replace is more efficient in the former case, as the target text typically contained several instances where *to the* was a correct translation, whereas almost all instances of *aux* in the input text were in names of dishes, and so could be deleted.

3.3.7. Discussion. Some of the examples we have just seen perhaps say more about the low quality of the particular system we have been using than about the question of interactive MT. But we feel they are indicative of and exemplify a further tactic available to the MT user. Compared to the more familiar pre-editing of the controlled-language approach, and 'normal' post-editing and revision, we have seen here a more local kind of editing activity, and a most important point to note is the very different status of the resulting input text. In the controlled-language scenario, the aim is to produce a source text which is easier to translate, but is still within the constraints of the grammar and style of the source language. But in the activity we are proposing here, no such constraints apply.

Clarifying the input text — like traditional pre-editing — results in an input text that is easier for the MT system to translate. But unlike traditional pre-editing, there is no requirement that in doing so the input text remain stylish, or even grammatical. The edited input text, unlike the pre-edited source text, has no status outside the context of the MT system, and so it is quite legitimate, even if initially counter-intuitive, to change the input text to make it more like some hybrid language, as long as the result is a better translation. The important criterion

is efficiency in getting the desired output text, not retaining any style (or stylishness) in the input text. So we are not afraid to make changes to the input that render it clumsy or even ungrammatical. All the examples we have seen were changes that could have been made in the normal post-editing way, but by changing the input rather than the output, there was some perceived gain in efficiency: it was *easier,* by some intuitive measure, to change the input than to change the output.

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