Translation Technology: Myths and Reality[1]

This article is intended as an introduction to some of the many types of computerised translation tool which are now revolutionising the way in which many translators work.[2] While machine translation forms the article's main focus, some space is also devoted to a number of tools which are not actually designed to perform the translation process themselves but which are intended to act as aids to the human translator. In view of the limited scope of the article, a number of more specialised types of translation tool – such as software localisation tools for example – are not covered.

1. Machine Translation

The term machine translation (MT) is generally used to refer to translation which is performed wholly or partly by computer. As is implied by this definition, such translation may be carried out with or without human intervention (whatever form that may take); however, if computer applications are simply used as productivity tools to improve the speed and quality of translation then it is more common to talk of computer-aided translation (CAT: see below). It must be said that there has been much cynicism about machine translation in some quarters, and many people have always been quick to point to some of the direr howlers which machine translation systems have purportedly produced. One story (apocryphal without a shadow of doubt), for example, describes how the English proverb *Out of sight, out of mind* emerged from an early English to Russian MT as 'invisible idiot'. And on a more scholarly level, Snell-Hornby expresses a common perception when she states that 'now there is no longer any doubt that the product of technology, however sophisticated, cannot compete with the creative power of the human mind.' (Snell-Hornby, 1988/1995: 66).

So does MT really work? Let us look at a couple of examples and see what conclusions it is possible to draw.

The first example is a short passage describing a famous translation school in Paris:

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[1] A number of sections of this article are based on a talk which the author gave at London Metropolitan University on 28 November 2002.

[2] The term translation technology will be used to refer generically to all different types of computerised translation tool.

Mark Shuttleworth

> La connaissance des langues n'est qu'un outil; la véritable compétence est de savoir transmettre le sens des discours et des textes. C'est cela que nous enseignons à l'Ecole Supérieure d'Interprètes et de Traducteurs. (Information on *L'Ecole Supérieure d'Interprètes et de Traducteurs* of the University of Paris, at http://www.univ-paris3.fr/esit/index-2.html; accessed 22 February 2003)

This text was selected more or less at random and passed through the free WWW-based MT system commonly known as Babelfish (about which more below). The translation which it produced is as follows:

> The knowledge of the languages is only one tool; true competence is to know to transmit the meaning of the speeches and the texts. It is that which we teach at the Higher School Interpreters and Translators.

This is certainly not a perfect, polished translation, but is considerably above what most people would informally describe as 'acceptable': there are no serious misrepresentations of meaning, and with just a small amount of fine tuning this text would be of publishable standard. And it certainly bears witness to the fact that widely-available, low budget (indeed, in this case, free) MT can produce high quality output. (There is even that apocryphal story about how Babelfish achieved a highly creditable 69% on a third-year undergraduate translation into French…)

Let us now look at a less fortunate example. This is the opening of the biography of Lucio Stanca, Minister for Innovation and Technology, as it appeared on the official Italian government website:

> Nato a Lucera (Foggia) il 20 ottobre 1941. Coniugato e ha due figlie. Nel 1965 si è laureato in Economia presso l'Università Bocconi di Milano. (available at http://www.governo.it/Governo/Biografie/stanca_lucio.html; accessed 23 February 2003)

The following rather less impressive-sounding English translation was spotted by a reporter from *La Repubblica* (Messina, 2001), also on the official Italian government website:

> Been born to Lucera (Foggia) 20 October 1941. Conjugated and it has two daughters. In 1965 one has graduated in Economy near the University Mouthfuls of Milan. (available at: http://www.repubblica.it/online/politica/biografia/stanca.html; accessed 22 February 2003)

Possibly following a misguided decision to save on the cost of having the material translated by humans, the English versions of many of the ministers' biographies have been produced by Babelfish (you can tell it was probably Babelfish as you get an identical result if you send the text yourself); interestingly, though, the translation of Silvio Berlusconi's personal biography shows no signs of having fallen foul of the same economy drive.

There are perhaps two main reasons behind the vastly different quality of output in the two cases. Firstly, the sentences in the second text are written in abbreviated form (for example, the subject is frequently omitted) and so do not conform to the system's internal grammar. Secondly, the fact that the name of the university where the minister studied is interpreted as a common noun leads to an absurd translation. This of course highlights the necessity of ensuring that the lexicons which the system is using are appropriate for the text being translated: a scientific text sent to Babelfish will probably come back with plenty of terms left untranslated, while if a more sophisticated, locally held system is being used it should be possible to utilise a specialised lexicon or to teach the system new words. Together, these two factors add up to the reality of the situation, which is that any text which deviates even slightly from a series of declarative sentences written in a standard, non-colloquial style will give rise to a more problematic translation.

It has taken around half a century for us to arrive at more or less this point. Back in the late 1940s and throughout the 1950s in the very early days of MT the original assumption had been that machine translation should eventually replace the human translator. Indeed, there was a high level of optimism felt at that time about the potential of MT. On 4th of March 1947 – a date which many feel marks the 'beginning' of machine translation – Warren Weaver, director of the Natural Sciences Division of the Rockefeller Foundation, wrote the following words:

> one naturally wonders if the problem of translation could conceivably be treated as a problem in cryptography. When I look at an article in Russian, I say 'This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode.' (Quoted in Hutchins, 1997: 15)

It is clear from a passage occurring earlier on in this communication that Weaver was not completely unaware of the problems that would be involved. However, what this extract reveals is the assumption that translating, like decoding, involves the one-to-one substitution of material in the source language/code with equivalent target material. Yet even a brief acquaintance with translation from one language to another should suffice to persuade one that this is not the case.

Take the seemingly simple sentence *Time flies like an arrow*, for example. As Steven Pinker observes, in the absence of a clue-providing context there are in fact at least five different ways of understanding this sentence:

1. Time proceeds as quickly as an arrow proceeds.
2. Measure the speed of flies in the same way that you measure the speed of an arrow.
3. Measure the speed of flies in the same way that an arrow measures the speed of flies.
4. Measure the speed of flies that resemble an arrow.
5. Flies of a particular kind, time-flies, are fond of an arrow.

(Pinker, 1994: 209)

Most people – all things being equal – will automatically assume that this sentence means something along the lines of the first proposed meaning. They will do this quite unthinkingly; indeed, it will probably not even enter their heads that alternative interpretations are possible. The fact is that natural (i.e. human) languages contain large amounts of potential ambiguity, at least 95% of which is automatically disregarded by native speakers. Non-native speakers of a language, when presented with a non-trivial text in that language, will often have to narrow down the possible meaning in a more conscious, deliberate manner. An MT system on the other hand will not only find it equally difficult to decide between several sensible interpretations of a given sentence or text, but will also quite possibly have no way of distinguishing between sensible and absurd interpretations. Hence in the above example it will not necessarily be able to identify which of these five possible interpretations is the right one (nor will it have any reason to interpret Pinker's superficially similar sentence *Fruit flies like a banana* along different lines).

Another slightly different – but clearly related – problem is the one which was pointed out in 1959 by the philosopher Yehoshua Bar-Hillel in what proved to be a highly influential report on the feasibility of MT. Bar-Hillel considered the following short text:

> Little John was looking for his toy box. Finally he found it. The box was in the pen. John was very happy.

He argued that it would not in fact be possible for an MT system to translate the word *pen* reliably, as to do so would require the computer to possess world knowledge, which would be totally impossible. (See Hutchins (1999) for a fuller discussion of Bar-Hillel's report.) Nowadays, research into 'knowledge-based MT' is being conducted with great intensity, although the prototypes that have been produced so far tend to be highly domain-specific and so able to solve only a small fraction of such knowledge-related problems.

A third major problem is that of anaphora resolution. An anaphora is of course a word or phrase which refers back to an element occurring earlier in the sentence, or in a previous sentence. Thus, for example, it is a non-trivial problem to create procedures enabling an MT system to distinguish between the various references of *it* in the three sentences *The monkey ate the banana because it was hungry*, *The monkey ate the banana because it was ripe* and *The monkey ate the banana because it was tea-time*. Quite clearly, a certain amount of disambiguation can be achieved by adding information to the system's lexicon: for example, if *monkey* is marked as being animate and *banana* as inanimate, and the entry for *hungry* indicates that it can only apply to animate entities, then we have gone a long way to solving the problem. However, there are plenty of instances for which such a relatively straightforward solution will not work (quite apart from the fact that marking up entries in this way creates the additional problem of what to do about metaphorical uses such as *A country hungry for a future*), so that this is a problem to whose solution many people are currently devoting much energy.

After a fairly stagnant period in the early 1970s interest in MT has been gradually reawakened. Modern approaches tend to be more realistic and level-headed than those which arose from the initial euphoria of the 1950s, and the previously-held assumption that machine translation should eventually replace human translation has given way to a more sober appraisal of its potential. It is indeed clear that humans are considerably more adept at analysing and interpreting natural language than even the most sophisticated machines, and that genres such as literary texts, advertising and promotional material are not generally suited to translation by machine (Newton, 1992a: 7). Fully automatic, high quality machine translation (sometimes known as FAHQMT) may indeed be impossible (given the present state of our knowledge, at any rate), but on the other hand, there are areas where the machine wins out, such as for example in spelling and terminological consistency (Newton, 1992a: 5) – which is of course extremely important when it is a technical, scientific or medical text that is being translated.

2. Types of MT system

Up to this point we have only been talking of MT systems in the most generic of terms. In reality, over the decades researchers have come up with a range of sometimes radically different system designs. The first design (or 'architecture') to be widely experimented with was the direct approach. Here, the individual words in a source text sentence are analysed morphologically, then substituted with their target language equivalents, and then rearranged in the correct order (so that, for example, *the white house* becomes *la blanche maison* which then becomes *la maison blanche*). In its simplest form this method quickly proved unsatisfactory as no attention was paid to context, nor indeed to building up an overall idea of the structure of the sentence being translated. Having said this, the approach still survives, albeit in a more sophisticated form; indeed, the Systran engine (which is what lies behind Babelfish) is in essence a direct system.

But in general the direct method fairly soon gave way to two other, more robust approaches, both of which offer significant advances over it, in that, for example, 1) the attempt is made to understand the entire sentence as a structural whole rather than producing morphological analyses of each individual word without regard to the context in which it appears, and 2) the system contains a detailed grammar not only of the source language (as was the case with direct systems) but also of the target language, thus opening up the possibility for more sophisticated translations to be produced. The first of these two related approaches is known as the transfer method. This consists of three distinct stages: analysis, transfer and generation (or synthesis). In the first stage the source sentences are parsed and then decomposed into a more abstract, but still source-language dependent, underlying representation. The result of the analysis stage may well appear in the form of a marked-up Chomskyan phrase structure 'tree' of the type that many readers may be familiar with, although other, alternative formalisms are also sometimes used. In the transfer stage this is then converted into a corresponding, more-or-less abstract target-language dependent representation of the sentence. Then in the final, generation stage this representation is converted into the real target language sentences which form the final output from the system.

The idea behind the transfer method is that the ‘deeper’ (i.e. the more abstract) the analysis the easier the transfer stage should be, since the greater the level of abstraction, the greater the similarity between the underlying representations of sentences in different languages. Thus if you take this idea to its logical conclusion you arrive at what is the second of the two approaches to have replaced direct MT. This is known as the interlingua approach. Unlike transfer systems, interlingua-based MT systems involve only two stages – analysis and generation – because here the source language material is converted into the target language via a single, highly abstract, completely neutral, language-independent representation, which is known as an interlingua. Thus there is no need for a separate transfer between distinct source- and target-language dependent representations. While there are considerable problems involved in designing satisfactory interlinguas, the approach has the theoretical advantage of streamlining the architecture of multi- as opposed to bilingual systems. It should also be noted that the knowledge-based systems mentioned earlier generally involve the use of an interlingua.

The 1980s saw the development of two new, radically different approaches to MT, both of which emerged from the growing tendency to exploit the massive amounts of information contained in machine-readable text corpora. The first of these is known as example-based machine translation (EBMT). This approach differs radically from all the other “rule-based” approaches described above, in that – in its pure form at least – the method dispenses with any kind of pre-programmed grammatical and lexical knowledge of the two languages involved. It does this by matching the sentences needing to be translated with sentences (or, more usually, fragments of sentences) occurring in the source-language half of an aligned bilingual corpus – the ‘examples’ of the title – aligning these sentence parts with corresponding sentence parts in the target-language half of the corpus, and then recombining these target sentence parts in such a way as to create meaningful translations of the original input. In reality, however, designers of EBMT systems often ‘cheat’ by including some linguistic knowledge in the system, or alternatively use EBMT methodology only for certain stages of the translation process.

The other method to have appeared in the relatively recent past is statistical MT (SMT). Like EBMT, this is reliant on the availability of vast amounts of data in the form of both monolingual and aligned bilingual text. In brief, what it involves is firstly a calculation, for each sequence of three words in the (source language) monolingual corpus, of the probability of the second word appearing given the first, and of the third word given the first two (the 'language model'), and secondly – this time using the bilingual corpus – the probability of a given three-word stretch of target-language text being the translation of a stretch of source text of similar length, taking into consideration factors such as the possibility of a word shifting its position in the sentence in translation or of a single word being translated by two or more words (the 'translation model').

Considerable amounts of research are still needed into these two approaches before they can begin to realise anything like their full potential. Consequently, no EBMT or SMT systems are commercially available as yet, although this is likely to start to change over the next few years.

MT can usefully be employed for translating more restricted text-types where the same terminology and grammatical constructions are likely to come up again and again. It is particularly efficient within an organization which has 'a large, constant flow' of texts of a certain type which need to be translated (Melby, 1992: 149); for example, the Canadian Meteorological Center in Montreal has been using a system called METEO since 1977 to produce highly readable English to French translations of weather bulletins totalling around 45,000 words a day.

3. Sublanguages and controlled languages

One reason why MT can be so effective in such cases is that many types of technical texts are written in what is sometimes called a sublanguage. A sublanguage can be defined as 'a language used to '" (Arnold *et al*., 1994: 216). According to Arnold *et al*., sublanguages are characterized by 'the high frequency of specialized terminology and often also by a restricted set of grammatical patterns' (1994: 216); thus the weather bulletins mentioned above, or also for example medical reports and business letters, can all be considered examples of this kind of language. One of the main advantages of designing a dedicated machine translation system to specifically cope with input in the form of a particular sublanguage is that the number of parameters which it will need to include will be considerably reduced, with the result that the quality of the output will be noticeably enhanced. For this reason a considerable amount of research is being carried out to improve performance in this area still further. However, a second advantage is that the use of sublanguages does not require the writer to simplify the source text (see below) but rather exploits the linguistic restrictions which naturally occur in the type of text being translated (1994: 159).

If for whatever reason the idea of a sublanguage is not of any help in a given situation, the writers of material which is to be processed by an MT system will often make use of what is called a controlled language when preparing their texts. This is defined by Arnold *et al.* as ‘a specially simplified version of a language’ (1994: 211), and is typically used by large organisations which have a massive multilingual documentation requirement. Writing or pre-editing MT input so that it conforms to the parameters of a controlled language considerably enhances the performance of most systems. It does this firstly by simplifying the grammar and vocabulary of the text to be translated, for example by shortening sentences, reducing the number of subordinate clauses and adding explicating words such as conjunctions. Secondly, a controlled language uses a limited vocabulary. The technical terminology can be very large, but general vocabulary items are restricted to the bare essentials and polysemous items are permitted only in one or other particular meaning (so that *replace* might mean to substitute rather than put back in position, and *record* might be restricted to appearing as a noun but not a verb). These limitations remove many of the ambiguities which the source text would otherwise contain and which the computer might be unable to analyse: for example, the sentence *Time flies like an arrow* suddenly looks considerably less ambiguous if it is explicitly stated that the item *flies* can only appear as a verb.

An example of a controlled language is AECMA Simplified English. This was designed by the European Association of Aerospace Industries, and its use is intended to increase the comprehensibility of aerospace technical documentation for non-native speakers of English as well as facilitating its translation into other languages.

While the performance of an MT system can be improved by controlling the input in the ways suggested above, it is important to remember that the raw output from an MT system does not need to be perfect in order to serve a useful purpose (Newton, 1992a: 4). As discussed above, one of the main uses of MT today is to provide a gist translation of a text which the (monolingual) user would otherwise be unable to read. But if necessary, a less than perfect output can always be post-edited to the extent that is appropriate to the purpose it is to serve.

The process of post-editing can be either interactive or non-interactive; however, for the use of MT to be economically viable, the expense and effort involved in post-editing must be less than that required for a full human translation, or there would be no point in using the MT system. On the other hand a flexible policy towards post-editing will recognize that translations are needed for different purposes, and that the level of post-editing will vary accordingly. Thus for example one text may be translated with no post-editing at all (possibly to find out whether it merits 'proper' translation), a second may require considerable post-editing in order to be presented in a highly polished state, while a third may simply need to be checked for basic intelligibility and accuracy before being submitted in a readable but less than perfect form (see Arnold *et al*., 1994: 33-4).

4. New applications

What has been said about sublanguage and controlled language applies first and foremost to the traditional area of application for MT, which as stated has been within large organisations with huge amounts of documentation needing to be translated. However, in the last few years with the rapid increase in both the availability and the power of personal computers this situation has started to change. PC-based desktop MT systems have begun to come on the market at highly affordable prices, thus giving rise to a major new application: enabling individuals to extract the gist from a text which they would be otherwise unable to read at all (an activity known as 'gisting'). Desktop systems currently available include, for example, Systran, Reverso, PROMT and Power Translator in various shapes and sizes. Furthermore, it is only a matter of time before operating systems start to include a translation facility as standard (as already happens in Japan, for example); in fact, the recently-released Beta version of Microsoft Office 2003 already provides this facility. Secondly, an event in November 1997 changed the MT landscape for ever, as this was when with Systran's backing AltaVista launched Babelfish, which was the internet's very first free real-time on-line MT-based translation service. Five years on, this phenomenon is very widespread, with Systran having been joined by other players such as PROMT, Amikai and InterTran. Interestingly, in most cases the engines used for the free on-line systems are identical with those which form the heart of desktop systems which need to be purchased. There are, however, other important differences, as desktop systems typically allow the users (depending on the amount of money spent, of course) to select specialist glossaries, to teach the system new words and to translate unlimited amounts of texts, most of which options are typically unavailable with WWW-based systems.

Of course it needs to be recognized that MT continues to suffer from unfair comparison with human translation, partly because we tend to have unrealistic expectations of what it is capable of; after all, it may be that rather than translating, the computer 'does something else, which may be similar in some respects, and the outcome of which is a derived document for which we have yet to find another name' (Sager, 1994: 119-20).

5. Other types of translation technology

The remainder of this article will provide an overview of other types of computer-based translation aids which have been developed over the last decade or two. The reality of the situation is that – rightly or wrongly – for most freelance and in-house translators MT is still something of an irrelevance, not to say a threat even. The aids and methodologies described below, then, do in fact have very little in common with the technologies that have been described up to this point.

6. Terminology management

As is well-known to any technical translator, terms in any specialist area can easily run into the thousands. In addition to this the fact that new terms are constantly being coined means that even the best technical dictionaries become out-of-date very rapidly, and thus for most people some method for recording them becomes essential. Furthermore, there is the need to ensure a sufficient level of standardisation: not only must terms be translated consistently, but the translator needs to ensure that they are being utilised along the lines of accepted usage and also in accordance with a particular client's preferences.

Terminology management systems have been designed to allow you to create terminology databases – of the technical vocabulary in a particular subject area, for example. Such databases can be constructed item by item as new terminology is encountered over a period of time, or they can be developed on a more systematic basis; they can be little more than simple bilingual word-lists, or else they can contain different fields various types of information (e.g. definition, source, synomyms, date of entry into database, identity of person who entered it, etc.) in multiple languages. Once created, databases can be searched in a number of ways and can also be used to look up words semi-automatically while working on a translation via the interface of a word processor. In this way such systems facilitate the recording, standardisation and retrieval of terminology.

Some of the better-known terminology management systems include TRADOS MultiTerm, STAR TermStar and Lingo. Another technology, known as terminology extraction, involves a piece of software scanning a corpus of texts in an attempt to identify items which it considers may be terminologically significant rather than being simply items of ordinary vocabulary. However, this is beyond the scope of the present article.

7. Computer-Aided Translation

If MT is an activity in which the actual job of translation is devolved to the machine, then in computer-aided translation the human user remains firmly in the driving seat. Sager defines CAT as ‘a translation strategy whereby translators use computer programs to perform part of the process of translation’ (1994: 326). In practice, however, its main area of application lies in improving speed and consistency for translators who work on texts which contain a significant amount of repetition or who are constantly being asked to translate updated or revised versions of texts which have already been translated, either by themselves or by others – in other words texts such as manuals and other technical documentation, software and web sites (although it has a clear potential application for other text-types too). The reasons for this rather circumscribed ambit will become apparent over the next few paragraphs.

In general terms, CAT revolves around the use of a translator’s ‘workstation’. Although it was first conceived of independently by various researchers in the late 1970s and early 1980s (see Hutchins, 1998), this idea was not fully implemented until the early 1990s. Although there are a number of slightly different conceptions of what elements a translator’s workstation should include, most typically such systems combine a text editor, a terminology facility (including automatic dictionary look-up), and what is known as a translation memory.

8. Translation memory

This is without doubt the main element of the translator's workstation. To get an idea of what it does consider the following items from a technical translator's possible wish-list:

- enjoy increased productivity
- access and reuse ideas from previous translations
- never translate the same sentence twice

Based on the idea that 'existing translations contain more solutions to more translation problems than any other available resource' (Isabelle *et al.* 1993:205), a translation memory is a database which is designed to store the original sentence plus your translation every time a sentence is translated, and then, using a matching process based on fuzzy logic, automatically suggest the old translation whenever the same – or a substantially similar – sentence recurs. Clearly, considerably more benefit is going to be derived from this facility by a translator who works on successive versions of computer manuals than, say, somebody who translates novels: not only is the amount of sentence-level repetition likely to be negligible in the latter type of text, but the technology is also based on the premise that if a translation of a sentence was correct the first time it will continue to be correct on all subsequent occasions on which the sentence occurs. With this important text-type proviso, though, the bigger the translation memory gets the more valuable it becomes since the chances of a match being found increase with the size of the database.

Despite the clear impact that the use of this technology can have on the consistency of translations and the speed with which they may be produced, the commercial translation memory systems currently available do have a number of limitations. Besides the fact that they only really come into their own when used to translate repetitive text, most systems only provide matches of entire sentences, which means that the significant level of repetition of common phrases which occurs in any text is just not picked up on. Another problem is that the context in which the translated sentence originally appeared is difficult to retrieve, as the user is typically only presented with decontextualised hits from the memory. Both of these are problems which are being addressed at the research and development level. A more practical problem, however, is the fact that useful translation memories take time to develop. When a translation memory system is purchased it is rather like an empty box, which is gradually filled with content as you use it over an extended period of time; the alignment tools which most packages include offer one possible way out, although the slow speed of the process of lining up old source texts with their translations sentence by sentence – and its sheer boredom factor – make it problematic too.

Major workbench systems include TRADOS Translator's Solution, STAR TRANSIT, SDLX, Déjà Vu and WordFast.

9. Conclusion

The above has been a brief overview of a very wide range of technologies. In the case of MT, the attempt has been made to sketch in the theoretical background in a fair amount of detail. Other types of application, which are more in the nature of translation aids than translation systems as such, have also been considered. It is to be hoped that what emerges from the article is a picture of a rapidly developing area which has the ultimate aim of serving translators rather than replacing them or making them obsolete.

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Déjà Vu: http://www.atril.com
InterTran: http://www.tranexp.com:2000/InterTran
Lingo: http://www.lexicool.com
PROMT: http://www.e-promt.com/indexe.shtml
Reverso: http://www.softissimo.com/index-e.htm
SDLX: http://www.sdlintl.com/sdlx
STAR: http://www.star-ag.ch/eng/home.html
Systran: http://www.systransoft.com
TRADOS: http://www.trados.com
Translate-Free.com (list of free WWW translation services): http://translatefree.com/
WordFast: http://www.champollion.net

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