1   Publishable summary

CASMACAT carries out cognitive studies of actual unaltered translator behaviour based on key logging and eye tracking. The acquired data is examined for how interfaces with enriched information are used, to determine translator types and styles, and to build a cognitive model of the translation process.

Based on insights gained in the cognitive studies, CASMACAT develops novel types of assistance to human translators and integrate them into a new workbench, consisting of an editor, a server, and analysis and visualisation tools. The workbench is designed in a modular fashion and can be combined with existing computer aided translation tools. The CASMACAT project demonstrates the workbench's effectiveness in extensive field tests of real-life practice of a translation agency.

1.1   Scientific Objectives

While there have been significant improvements to machine translation technology, the vast majority of this work is targeted towards bulk translation that is *good enough* or *fit for use*. A user on the Internet is satisfied with a rough translation, if it fills her information need. Opposed to that is the demand for high quality translations by the marketplace: the translation of reports and announcements of multi-national organisations, marketing material and product descriptions of commercial companies, and many other localisation needs. Such high quality translations are still almost exclusively provided by human translators.

Productivity of human translators can be increased with computer aided translation (CAT) tools: translation memories are standard in the translation industry, but post-editing machine translation output is only slowly becoming an increasingly used practice. The current integration of machine translation technology into human translators' work processes is often done overly simplistic, breaks their work practices, and it is widely resisted.

Hence, the CASMACAT project carries out in-depth study of translator behaviour to tailor the tools to the requirements of translators, and not the other way around. The project builds a novel workbench that increases the productivity of human translators by addressing their needs for the right type of assistance at the right time.

Prior to the project, there has been some progress in aiding human translators, but the vast potential of creating a new workbench for human translators has been mostly unfulfilled. The CASMACAT project believes that the transfer of methods from the statistical machine translation community can be of great benefit to the task of assisting human translators. Whereas the translation technology is ripe enough, design issues of the user interface and its acceptance by the translator have been widely neglected. The development of such tools must not simply follow technical possibilities, but it should be driven by a better understanding of the behaviour of human translators.

1.2   Scope

Human translation is performed by different types of translators, tackles different text types, and deals with different language pairs.

Translators – The project addresses the needs of user communities that range from professional translators to volunteer translators (participating in efforts such as TED, Global Voices or Wikipedia.

Text Types – Much of what professional translators translate is repetitive, technical material. Volunteer translators are more commonly interested in generally accessible material, while monolingual translators seeking out information which may be very technical in their own area of expertise.

Language Pairs – Statistical machine translation methods do not work equally well for all language pairs. Translating between syntactically divergent languages or translating into morphologically rich languages is more difficult. The CASMACAT project tests its workbench on different language pairs (involving English, Spanish, Danish, and German).

1.3   Workbench

The CASMACAT project will develop a new open source workbench for human translators, in collaboration with the MATECAT project, a parallel EU Framework Programme 7 STREP. All functionalities developed by the project will be integrated in a web-based online service which may also be installed locally on the desktop of a translator. All new features explored in the project are implemented within the new system.

The availability as web service will make it easy to integrate it into existing translation workflows. The important aspects will be (1) integration with real-time interactive translation prediction systems, (2) novel editing possibilities with e-pen, (3) connection to eye-tracking hardware for detailed analysis, and (4) extensive logging facilities.

1.4   Cognitive Analysis

An important objective of the CASMACAT project is to gain insight into the cognitive processes involved in human translation. How large are the text segments actively considered by a translator (the whole text, individual sentences, or only subsentential segments of limited length)? What are the subtask that a translator spends most time on – e.g., understanding the source text, looking up unknown words, investigating lexical translations, syntactic restructuring of the sentence, ensuring fluency of the output? How does translation differ from well-studied simpler cognitive processes such as reading and text production?

The cognitive analysis informs the design of the CASMACAT translation workbench in a range of ways. It determines what types of assistance are offered to the translator, what information should be displayed on the screen, and what information should be hidden as it would be distracting. The project evaluates different versions of the user interface in user studies using eye-tracking and other commonly used methods in cognitive analysis.

1.5   Advanced Computer Aided Translation

CASMACAT uses well-established statistical methods and explores novel approaches in order to generate and disambiguate translation proposals. Dynamically generated translation options will be sent to and visualised in an interactive translation assistance tool. Two basically different approaches to CAT, *Interactive Translation Prediction* and *Interactive Editing*, are developed, compared and evaluated and a cognitive model of the translator will be developed to predict the translator's performance.

A novel reworking of the idea of *interactive translation prediction* (IMT) allows for the construction of systems that produce high-quality results by placing a human operator at the centre of the production process. The IMT paradigm embeds a statistical MT engine within an interactive editing environment. The human serves as the guarantor of high quality; the role of the automated systems is to ensure increased productivity by proposing well-formed extensions to the current target text, which the operator may then accept, correct or ignore. Interactivity allows the system to take advantage of the human-validated portion of the text to improve the accuracy of subsequent

predictions. This interactivity can be applied both to the basic machine translation and to the post-editing of the output of a machine translation system. In this new framework we will develop:

1 New models, search and machine learning criteria for translation prediction
2 New different modalities to interact with the system
3 Techniques that allow the system suggest the parts to be corrected
4 Active learning and on-line adaptation to new scenarios and translators.

1.6 Field Trials

The CASMACAT workbench is integrated into the workflow of the professional translation agency Celer Solutions which tests the workbench under realistic work conditions. The project measures the effectiveness of its approach by carrying out user studies that measure the productivity of human translators.

CASMACAT fosters adoption of its methods by the translation industry by forming a user group of early adopters. The project also co-operates with translation communities who are able to make use of customised versions of the workbench. This allows the collection of usage data under real-world conditions which will be used for further evaluation of the system. The adoption of the CASMACAT workbench by various sectors of the translation community is an important outcome of the project.

1.7 The Consortium

The CASMACAT project brings together capable research groups with strong track records that have been approaching the problem of computer aided translation from different angles.

Copenhagen Business School brings in a leading research group with a long track record on translation process studies, while the **University of Edinburgh** also has broad experience in cognitive modelling of language processing. Edinburgh and the **Polytechnic University of Valencia** host leading research groups in statistical machine translation groups, as demonstrated by competitive performance of their systems in open evaluation campaigns and Edinburgh's widely used Moses toolkit, which will be extended in this project. Both groups have also developed innovative computer aided translation tools. **Celer Solutions** has been on the forefront of deploying advanced innovative computer aided translation technology in their daily operations.

This is the first European project that brings together the leading groups spanning the whole range from cognitive modelling to statistical machine translation and computer aided translation technology research and development and finally deployment.

1.8 Progress in Year 3

In the final year of the project, there was a stronger focus on integration of developed technologies and field testing. The work in WP1 on cognitive studies focused on practical suggestions for configurations of the workbench. Work in WP2-4 mainly refined developed methods based on the findings of WP1 and the field trials of earlier years. In WP5, all technologies that showed promise in lab tests were integrated into the workbench, and a standalone version of the workbench, called the CASMACAT Home Edition, was developed. In WP6 we carried out field trials and integrated the workbench into community translation platforms, in WP7 we engaged with users and set up external field trials to further field test the functionalities of the workbench. We also organized a number of events to promote the outcomes of the project and to promote the broader research agenda of advanced computer-aided translation with the special focus on interactivity and adaptivity.