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Multimodal Interactive Disambiguation: first report on the MIDDIM project

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A cooperative research project between CNRS (GETA, Grenoble) and ATR-ITL has recently started, for a duration of three years. It concerns multimodal interactive disambiguation, and is called here MIDDIM for short. The stay of H. Blanchon at ATR in July has been the first of the planned exchanges.

This report presents an overview of MIDDIM, elaborates on its scientific goals, sketches a possible program of work for the first year, and gives a second version of what has been produced in July: a table of ambiguity types and a bibliography.

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Contents

Introduction

A Memorandum of Understanding has been signed between ATR and CNRS[1] on 13 May 1991. It covers a period of five years. Specific cooperative research projects were to be organized under this memorandum.

The MIDDIM project on multimodal interactive disambiguation is one such project. It involves ATR-ITL and GETA-IMAG-CNRS. Following a suggestion of Dr. K. Habara, Chairman of the Board of ATR International, and in active cooperation with Dr. A. Kurematsu, President of ATR Interpreting Telephony, I have prepared and submitted a proposal to ATR and CNRS in November 1992. After this proposal had been discussed during a visit of a high-level delegation of CNRS to ATR on 2 February 1993, it was put in the required contractual form, with the help of Dr. Y. Yamazaki, President of ATR Interpreting Telecommunications, and Mr. T. Morimoto, Head of Department 4. It has been officially signed in May and July 1993 by both parties.

This project should last three years, starting in July 1993, and conclude by a pre- or post-COLING seminar organized in France in the summer of 1996. Its goals are relatively modest, in order to limit the commitment of each party to sending researchers to the other party on a yearly basis of 2 man*month. The stay of H. Blanchon at ATR in July has been the first of the planned exchanges.

It is interesting to conduct this cooperative research because (at least):

- past research as well as future projects of both partners are quite complementary;
- it is important to consider two languages of very different groups to study disambiguation techniques for text and speech translation;
- the types of ambiguities appearing in the contexts envisaged by ATR, as well as the degree to which they have to be solved, and the ergonomic constraints imposed on the disambiguation process, are quite different from those studied at GETA or in other European or American projects involving disambiguation.

The remaining of the report is organized as follows. First, an updated version of the proposal gives an overview of the project : its participants; its goals, and its organization. The refined scientific objectives and a sketch of the program of work for the first year are then presented, as they have been discussed at meetings held last July at ATR. Finally, the second version of a preliminary form of the future MIDDIM ambiguity database and MIDDIM bibliography we would like to build during this project is included.

[1] Centre National de la Recherche Scientifique, Paris, France.

I. Overview of the project

1. The teams and their main research directions

1.1 Presentation of ATR-ITL

ATR (Advanced Telecommunications Research) is the first research institute of the new technological city of Kansai. ATR's research laboratories cover various fields. In particular, a first project, by ATR Interpreting Telephony Research (1986-93) has produced a prototype of spoken translation, from Japanese into English and German, of dialogues in the field of conference registration, as well as various studies on discourse and dialogue. In cooperation with American and German teams (CMU, Pittsburgh; Siemens, Munich, University of Karlsruhe), a three-way demonstration involving the six language pairs has been held on 28 January 1993, using commercial telecommunication lines.

The new project has been started by ATR Interpreting Telecommunications Research in April 1993. It is planned that ATR-ITL will center its research on more "natural" processing of more "spontaneous" speech. Naturalness will require modelling the 3 dialogues arising during interpretation (between the speakers and the interpreter), and spontaneousness will force to handle self-modifying utterances (false starts, corrections...).

Achieving more naturalness and spontaneousness will not be possible without introducing interactive disambiguation. With multimedia telecommunications in mind, multimodal (and multimedia) interactive disambiguation is an interesting topic. Work is already being done to build a multimodal simulator, which will allow researchers to gather data in realistic situations.

1.2 Presentation of GETA

GETA (Study Groupe for Machine Translation) is one of the laboratories of the IMAG Institute (IMAG means "Computer Science and Applied Mathematics at Grenoble"). IMAG groups about 700 researchers, research engineers, university lecturers and Ph.D. students, pertaining to 9 laboratories. Almost all these laboratories are common to 2 of the 4 universities of Grenoble, UJF (University Joseph Fourier — Grenoble 1) and INPG (Institut National Polytechnique de Grenoble), and to CNRS (Centre National de la Recherche Scientifique). GETA itself comprises about 25 researchers (computer scientists and linguists). In France, GETA is the only laboratory having produced complete MT systems (software and lingware), and, after the end of the Eurotra project, it is currently the only one active in the domain.

Research in MT has been pursued at Grenoble since 1961, at CETA until 1971, and at GETA since then. From 1961 to 1971, CETA, under the guidance of regretted Pr. B. Vauquois, researched *MT for assimilation* (access to information in foreign languages, requiring large coverage, medium quality, and no postediting), and created the first ever MT system based on transfer through a "pivot" and on SLLPs (specialized languages for linguistic programming, rule-based and symbolic). This system was applied mainly to Russian-French (tests on about 1 Mwords, or 4000 pages). Academic cooperation with Japan started about 1965, and several Japanese researchers staid at CETA for extended periods (most notably

Pr. Sakamoto and Pr. Nagao). Several current commercial systems are in effect based on or strongly inspired by CETA's architecture (LOGOS, METAL, SUSY, ATLAS, PIVOT).

From 1971 to 1988, GETA turned to *MT for dissemination* (automatic translation followed by postediting, requiring restriction to a sublanguage and high quality before postediting). GETA created a universal MT shell for multilingual MT systems, called ARIANE-78. New SLLPs allowing linguists to mix declarative and heuristic programming were introduced. Besides a large Russian-French system, developed and tested under operational conditions between 1980 and 1987, GETA experimented a new linguistic methodology on various languages, mainly in cooperative frameworks (German, Portuguese, English, Chinese, Malay, Thai, and Japanese during Pr. Tsujii's stay in 1981). This methodology is based on a "multilevel transfer", the intermediate structures being a kind of head-driven tree structures annotated with "lexical units", more abstract than words, and semantic as well as syntactic features and relations. Translation is not done sentence by sentence, but rather paragraph by paragraph. This architecture has strongly inspired several current commercial MT systems (MU-MAJESTIC, PENSEE, HICATS, and of course the industrial version of ARIANE/F-E developed by B'VITAL and then by SITE in the framework of the EUROLANG project).

Since 1988, GETA has turned to the study of *personal MT for monolingual authors* (requiring large coverage, high quality, no postediting, but allowing for interactive input and analysis). This theme federates several research axes (interactive disambiguation, multilingual lexical databases, tools for linguistic programming, etc.).

GETA is currently developing a mockup, LIDIA-1, for translating French into English, German and Russian. An important part of the research has centered on techniques for interactive disambiguation in the source language. The linguistic methodology is still based on multilevel structures, with the addition of one level for interlingual acceptions. Heuristic programming is replaced by "ambiguous programming" and interactive normalization and disambiguation. The "guided language" and "lexical profiles" approaches have been introduced to retain the advantages of suboptimization (use of sublanguages) while permitting a very large grammatical and lexical coverage. This "dialogue-based" approach has been taken by some large operational systems (ITS, LMT to a certain point, N-Trans, and JETS by IBM-Japan).

In this context, GETA is interested to research multimodal interactive disambiguation, where the users can guide the system while speaking or typing, and/or answer direct or indirect questions using several modalities besides written or spoken natural language. Cooperation with ATR is expected to be mutually beneficial, since GETA has already researched interactive disambiguation, but has no competence in speech processing, while the contrary is true of ATR. Moreover, due to inherent limitations in purely automatic speech recognition and language analysis, multimodal interactive disambiguation will necessary in any future practical speech translation or interpretation system.

2. Goals

2.1 General scientific objective

The project aims at studying multimodal interactive diasambiguation methods within the contexts of personal machine translation of written texts by monolingual authors and of speech translation of dialogues between monolingual locutors (interpreting telecommunication).

In the initial presentation, we spoke of "multimedia" disambiguation. It seems, however, that the term "multimodal" is more appropriate, as the envisaged contexts will require other modalities than natural language, such as graphics. Multimodality implies multimedia, but not conversely.

Interactive disambiguation may be performed using only text, only speech, only graphics, or any combination of the three. It is hypothesized that higher efficiency will be reached in multimedia contexts, where different techniques and communication channels can be combined.

The objective of the project is to study which combinations are adequate in the envisaged contexts, and how to implement them in practice.

2.2 Expected contributions of both partners

a. Contribution of ATR

The contribution of ATR should be in 3 main areas, not yet researched at GETA:

- speech processing, both in analysis and synthesis, where notable progress has been made since 1986;
- availability of a large data base of transcribed spoken dialogues, and possibly of a data base of spontaneous spoken dialogues;
- previous studies on certain automatic disambiguation techniques in the context of spoken dialogues, based on discourse analysis.

a. Contribution of GETA

The contribution of GETA should be in 3 main areas, not yet researched by ATR:

- generation of written disambiguation dialogues, studied since 1989 in the LIDIA project in the context of text translation;
- multimodal/multimedia techniques for general users;
- previous studies on a great variety of languages giving some interesting insight in the "contrastive" ambiguities and possible ways to solve them.

2.3 Expected results

Expected results include:

- the development of a unified conceptual and algorithmic framework for disambiguating both written text and spoken dialogue, through interactions involving text, speech and graphics;
- studies on the efficiency of the possible techniques in the various contexts envisaged;
- publications;
- the organization of an international seminar on multimedia interactive disambiguation at the end of the project.

3. Organization: methodology and planning

Researchers at both sites should investigate disambiguation techniques appropriate in their particular context. Through exchanges, they will try to integrate techniques developed in the other context in a unified conceptual and algorithmic framework.

These exchanges will occur through e-mail and during mutual research visits. Each party will send researchers to the other party on a yearly basis of 2 man*month.

Progress will be monitored on a regular basis. If possible, co-signed scientific papers will be produced.

Finally, an international seminar on multimodal interactive disambiguation will be organized in France as a pre- or post-COLING event in the summer of 1996.

II. Refined objectives and programme

1. Refined scientific objectives

The scientific objectives of the project have been made more precise last July, at meetings involving MM. T. Morimoto, F. Yato, K. H. Loken-Kim, M. Seligman, H. Blanchon, and Ch. Boitet. There are two main topics: the study of ambiguities, and the study of methods to solve them.

1.1 Study of ambiguities

That study should be qualitative, quantitative, and relative:

qualitative: ambiguity should be organized by linguistic criteria, and appropriate examples should be provided, in both envisaged contexts.

quantitative: the frequency of occurrence of each type of ambiguity should be researched, again in both contexts. Finer divisions may have to be considered.

relative: the relative importance to solve each type of ambiguity in each context should be researched, as some relatively rare ambiguities may be more damaging to the task at hand than more frequent ones.

The result of that study should be presented in a usable form. At the very beginning of the project, we have simply produced a table. During the first year, it is planned to put it in a data base format, such as 4D™ on the Macintosh, which is multiscript and available at both sites.

1.2 Studies of methods to solve ambiguities in multimodal context

That study should concern both automatic and interactive methods.

automatic: it is possible that multimodality makes it possible to solve automatically a large fraction of some ambiguities which are almost impossible to solve using the linguistic forms only (e.g., the use of graphics or icons may help solve anaphoric relations).

interactive: as automatic methods will certainly leave a large number of ambiguities unsolved, this would be the main part of the study.

The study of interactive methods should lead to propose experiments for the simulator. For example, it should be possible to write a relatively simple program which would prompt the "wizard" to ask a disambiguating question of a certain type (or types), at a given moment, so as to reach a preset goal of frequency of questions and relative frequency of each type of question.

1.3 Building a bibliography on multimodal disambiguation

The link between multimodality and Natural Language Processing has just recently started to be investigated, so that there is no established journal or conference where to look for information. Hence, collecting a bibliography on multimodal disambiguation will be necessary and useful.

2. Sketch of program of work for the first year

This is only a sketch, to be refined during the visit MM. T. Morimoto and F. Yato are scheduled to pay to GETA on September 18-19.

In principle, ATR should send two researchers for one month in May-June 1994. GETA might send two persons for 2 weeks, or one person for one month, before or after.

From September until the next research visit, e-mail will be used to communicate progress in the three areas mentioned above.

It might be stimulating to aim at producing one conference paper in common at the end of the first year of the project.

The schedule for the research visits will be refined and extended as time goes, thereby trying to always have at least an estimate for the next twelve months.

III. Table of ambiguity types, version 2

This table has been prepared by H. Blanchon, M Seligman, and Ch. Boitet. It should be refined in the future, by the addition of realistic examples from the two contexts of Machine Interpretation and Dialogue-Based Text Translation for monolingual authors. If possible, frequency of occurrence in both context should be recorded. We will try to put this information in data base form in the future.

Category	*Sub-category*	*Text / Speech*	*Examples*
SEGMENTATION	WORDS	S	FRENCH l'amitose — *the amitosis* la mitose — *the mitosis, cell division* l'essieu — *the axle* les cieux — *the heavens, the skies* la pesanteur — *the gravity* l'apesanteur — *the weightlessness* Gal, amant de la Reine à la tour magnanime, *Gal, lover of the queen with the magnanimous tower,* Galamment de l'arène alla Tour Magne à Nîmes. *gallantly from the arena went to Tower Magne at Nîmes*
		T S (kanas)	JAPANESE monogatari nai — *there's no story/tale* mono ga tarinai — *there isn't enough stuff*
		S	ENGLISH the speech *this beach*
	TERMS	T S	FRENCH Il convient [avec le gardien de l'ordre] du jour *He agrees with the police officer about the day* Il convient avec le gardien [de l'ordre du jour] *He agrees with the guardian about the agenda* Il le voit peu à peu près tous les jours *He sees little of him almost every day* peu à peu — *little by little* à peu près — *nearly, almost*
		T S (kanas)	JAPANESE Oshokujiken *O shokuji ken (a meal ticket)* *Oshoku jiken (a corruption case*
	SENTENCES	S	ALL LANGUAGES

ACTUALISATION	TENSE	T	ENGLISH I read *present, past*
		S	FRENCH j'aimerai *I will love* j'aimerais *I would love*
	ASPECT	T S	JAPANESE Kare ga hashitte iru. *He is running.* *He has been running.* Douji-tsuuyaku o youi-shite-imasu. *We are preparing a simultaneous translation* *We have prepared a simultaneous translation*
		T S	FRENCH Le médecin est arrivé. *The doctor arrived.* *The doctor has arrived.*
	PERSON	T S	GERMAN Sie kommen. *you [non-intimate] come, they come.*
		S	FRENCH ils parlent, il parle *they speak, he speaks (spoken only)*
	NUMBER	T S	ENGLISH He ate the fish. singular, plural He saw the sheep. singular, plural
	DEFINITENESS	T S	John had to go to the hospital *Surface marking is clearly definite, but meaning may in fact be indefinite*
	GENERICITY	T S	The lion is a magnificent beast. *Lions are magnificent beasts. (generic)* *The lion we spoke of (not the tiger) is a magnificent beast. (non-generic))*

COMMUNICATION	Intimacy	T	S	You *Sie or du? Vous or tu?*
	Politeness	T	S	I *Watakushi? Boku? Atashi? Ore?*
	Formality	T	S	You *Anata? Kimi? Anta? Omae? Temae? Person's name?*
	Social level	T	S	I wrote it. *Kakimashita? Kaita?*
MODALITY		T	S	He should come soon. *Kare ga sugu kitara ii to omou.* (It would be good if he came soon.) *Kare ga sugu kuru hazu da.* (I expect he will come soon.)
REFERENCE		T	S	The soldiers fired at the women and they fell. *who fell?* John hit Fred. He started to bleed. *who started to bleed?* I asked him to go out. *to let me go out? to go out himself?*
INTENTION	IFT Speech Act	T	S	Hai. *Yes, that's right.* *Okay, I will. Yes, sir! All right.* *I'm listening. Mm hmm.* *Here. Take this.* *Yes? What do you want? What can I do for you?* *Hello? (on the phone)*

IV. MIDDIM bibliography, version 2

1. Presentation

This is the second version of the bibliography to be created, used and expanded in the context of the MIDDIM project, in cooperation between ATR-ITL and CNRS-IMAG-GETA. The first version has been attached to H. Blanchon's report to ATR (23 July 1993).

2. Excerpt of the bibliography in our BibTeX exchange format

The list of references has been slightly augmented, and put in EndNote™ format, which will make it possible to use it as a source for citations in documents, especially Word™ documents, and to produce it in any other desired format by creating an appropriate EndNote "style" and exporting it into a file using that style. Here is an example in our "BibTeX Export" format.

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 title = "Dialogue-based MT for monolingual authors and the LIDIA project"
 institution = "IMAG, GETA, UJF&CNRS, Grenoble"
 date = "mai 1993"
 type = "Rapport de Recherche"
 number = "RR-918-I"
}

@incollection{"John M. Carrol and Robert L. Mack and Wendy A. Kellogg.1991",
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 year = "1991"
 title = "Interface Metaphors and User Interface Design"
 editor = "H. Helander"
 booktitle = "Handbook of Human-Computer Interaction"
 city = "Amsterdam"
 publisher = "Elsevier Science Publishers B.V."
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pages = "67-85"
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These references now concern the following 4 areas:

- multimodal interaction and human-machine interfaces,
- disambiguation using speech synthesis,
- speech translation (3 references),
- state of the art in speech processing (2 references).

It is expected that the list of topics will be refined and reorganized in the future, while the list of references should grow considerably, due to the emergence of multimedia and multimodal human-machine and human-machine-human communication as a new and challenging research topic.

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Conclusion

This report is the first report on the MIDDIM project. It has given an overview of the project, its refined scientific goals, the sketch of the program of work until July 1994, and a second version of a table of ambiguity types and of the MIDDIM bibliography on multilingual disambiguation. It is hoped that this progress will contribute some new insights into multimodal natural language processing, and new tools for future MT and MI systems using interactive disambiguation.

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