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AI Research In France

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Abstract

In the first section, some characteristic features of AI research in France are presented, including difficulties with the current means and the current organization of AI research. In the second section, the state-of-the-art in different areas of AI is described. Besides some weaknesses, and in spite of the general difficulties mentioned in the first section, strong points and great potentialities are exhibited. This allows us to conclude that AI research in France may play an important part at the international level, if the necessary means for its development in the middle and the long term are given.

It is no easy matter to review all AI research in an entire country. First, AI is not a very well defined area. It is a domain of research in itself for some people, and it is also a set of techniques that may be used for various applications in many domains. The intersection between AI and application domains is more or less large, more or less diffuse, more or less confused, sometimes hidden or sometimes amplified (for political reasons more than scientific ones).

To these difficulties, which exist everywhere, is added the fact that AI research in France is widely scattered. Most research teams are small or very small, and they are established throughout the whole country. They are localized in universities or in other public organizations as well as in private companies.

Thus, in order to satisfy the request of the *AI Magazine*, we have been confronted with a nonobvious problem of gathering information. We have carried out investigations at each place where activity in AI was known to us, and have tried to synthesize the information collected. (Unfortunately our survey is probably not exhaustive and we apologize to those whose work has been unintentionally omitted). At the end of this article, we will give a list of organizations where significant AI research is carried out.

Many of our remarks match up with a very interesting report on AI in France that was written in 1983 by the INRIA SICO Club and the CNRS.* This report was published in the *Technology and Science of Informatics* journal (English translation of the French journal *Techniques et Sciences Infomatiques*), Volume 5, Number 2, edited by North Oxford Academic, England. The report contains a review of current AI work from which we have borrowed some extracts with the kind authorization of TSI. It also presents interesting proposals for concerted development efforts with the support of public authorities. This theme is not dealt with in this article; our purpose is only to describe the state of AI research in France at the present moment (approximately mid-1984).

In this first section we will present some characteristic features of AI in France. Many remarks in this section are rather negative, and express the difficulties of AI in France: public image, weakness of means, relations with industry, and insufficient support from authorities.

In the second section we will describe the state of the art in different areas of AI: Fundamental Methods, Languages, Machines, Expert Systems, Linguistics, Speech Processing, and Computer Vision. Besides some weaknesses, and in spite of the general difficulties mentioned in the first section, we can identify interesting strong points in French AI research and notice that it presents great potential. This allows more optimistic conclusions about the future of AI in this country.

*See Appendix for abbreviations used in this review.

The Difficulties of AI Research in France

The Image of AI

There are two images of AI in France. On one side there is a public image, as AI has become more visible in recent years to the general public. There is not a single scientific magazine of large distribution that has not recently published one or more popularizing articles about AI, particularly about expert systems. Congresses and various meetings on the subject have multiplied, most in order to educate nonspecialists. The result is an increasing interest among a large public, including industrialists.

On the other side, the AI image is a rather negative one in many scientific environments, and, by consequence, in many critical circles of decision, particularly with the public authorities. There are several reasons for that negativism.

First, France is the country of Descartes, and French scientists are well-known as having taste (and, in general, good ability) for all that is theoretical and well formalized. One cannot claim that AI is such a field, as it is still an experimental science in which empiricism plays a large role. Our inability to justify heuristic reasoning theoretically offends, in some way, the French scientific spirit.

Second, AI and the techniques of AI have not yet brought sufficiently spectacular results that would make some people, at least in our country, forget the previous deceptions in AI applications of the 1960s (like the Automatic Translation Project in England) and forget the "toy image" of AI given by the application to various games. However, concrete realizations have begun to improve the situation. For instance, marketable expert systems are being developed in France, such as SECOFOR (Elf-Aquitaine) and LITHO (Schlumberger) in the oil industry, or CESSOL (LIA) in Civil Engineering. Nevertheless, it lacks several large-scale and very profitable realizations that could definitively convince the investors.

Finally, as shown in the following part of this article, the means of AI research (in personnel as well as in material) are most insufficient. This does not contribute to developing convincing realizations that would give a better image of the domain.

The Means of AI Research

If there are no more significant results, more concrete repercussions of AI research, it is in great part because of its lack of means in personnel as well as in material. We have counted only 200 researchers whose major activity is AI research. Moreover, they are very scattered. The teams are small (ten is a very big number) or very small (groups of three to five researchers are the most frequent); they are distributed throughout the whole country (Paris and surroundings, Toulouse, Grenoble, Nancy, Rennes, Lannion, Chambery, Marseille, Nice and so forth); and they belong to public or private organizations. As the variety of themes of AI increases, there are obvious difficulties for all these small research teams to communicate efficiently. Furthermore, for many of these teams, AI is not the single central theme of their research, which complicates this communication problem.

We also must emphasize how insufficient are the means of most teams at the material level in terms of equipment (computers, networks) and working allocations (computing time, traveling). This is particularly true for the smallest teams which, nonetheless, account for most of the human potential.

At the educational level, the situation is no better. As a matter of fact, there are few available people for creating and carrying out programs of education in AI. Most of the capable specialists are overloaded by other teaching activities, by research, or by connections with industry for applications. There are few AI courses, they are too short (one year or less), and their contents are not homogeneous. They are available only at the end of studies (Diplomes d'Études Approfondies (DEA) and Doctoral theses in some universities, or specialization courses in some engineering schools) and are too often mixed with other themes (robotics, pattern recognition).

A large effort should be made for AI education, to insert it earlier in the classical curriculum of computer science (at the license level and at the maitrise level) and to develop DEA totally specialized in AI (such as the DEA of the University Paris 6, the single one in this case). At the moment, we must deplore the paucity of specialized courses of education in AI. If unchanged, it cannot improve the personnel for research.

Let us also mention that, since the industrial demand for AI applications has increased, companies often take on students who are insufficiently trained. This phenomenon presents two dangers: first, a risk of negative experiences and serious disillusionment; second, the risk of drying up the recruiting for research, if the students do not take the time to complete their education in the research laboratories.

AI and Industry

The French industrial circles show an increasing interest in AI. Certainly, it is not without relation to the widespread vogue supported by journalistic papers in many professional magazines. Some industrial organizations which do not have a real knowledge of AI and of its possibilities, are inclined to believe in miracles and to ask AI to solve everything (how, for instance, can one build an expert system if there do not exist human experts?). As we have mentioned above, those industrial organizations have a tendency to take on insufficiently trained people.

Thus, there is a risk of deep disillusionment that could be catastrophic for AI in the middle term. One can guess the tricky dilemma for AI researchers. They must speak

in praise of AI and of its possibilities in order to get the means that they absolutely need, but they also must be very careful not to give rise to premature hopes in this or that domain.

Fortunately, some other industrial organizations are not only aware of the importance of AI and of its future market, but are also conscious of its current limitations. These organizations endeavor to take on well-trained people for reasonable applications. Some of them, which have the necessary size and determination to invest in AI for a longer term, have developed their own internal center of research in AI. The case of the CGE Company (see the MAIA project below) is in this respect quite exemplary. The Marcoussis Laboratory (near Paris) of the CGE has about 20 high-level researchers, which makes it one of the biggest French research centers in AI, along with the GR22 of CNRS (Paris AI), the CNET (Paris and Lannion) and the LRI (Orsay, near Paris), which are all public laboratories. Unfortunately, there are not enough examples like the CGE. Among them, one may mention the Bull Company and to a lesser extent, Elf-Aquitaine and Schlumberger-France. We may also notice recent creations of software companies specialized in AI developments: Framentec (a joint venture of Framatome and the American company, Teknowledge), PROLOGIA, ITMI, CRIL and Cognitech. This is the proof that there is an increasing AI market in France.

Obviously, it is essential that there be many examples along the line of the CGE research center. This should be the real way to improve the cooperation between industry and public research, which is not very efficient at the present moment. Industry is not singly responsible for this situation: many researchers in the French universities prefer fundamental to applied research, and they neglect too often the contact with industry and the real world.

AI and the Authorities

At the present moment no concerted action supporting AI research as a specific activity has been carried out (with the small exception of ATP-CNRS of 1979, see below). On the other hand, many areas in which AI is a component are supported.

Since the October 1981 public announcement of MITI's Fifth Generation Project, the French scientific and industrial communities have exhibited an increasing interest in AI languages, expert systems, man-computer interaction, novel computer architectures, and, as a whole, knowledge-based computer systems. To be anecdotal, the choice of the Prolog Language by the Japanese project has allowed many of our fellow countrymen to be aware of the existence of a basic AI tool designed mainly in France, thus to be aware of the existence of French AI research.

Certainly, it would be inaccurate to say that the French "fifth generation" projects go back to the Japanese announcement. The MITI project has surely been a catalyst for a certain ministerial and industrial awareness, but some of the ongoing projects originate from earlier work.

One cannot identify in France a grand cooperative project encompassing all the facets of MITI's Fifth Generation project. Research and development initiatives relating to these various facets correspond more to a set of distinct projects that complement each other by their technical scope as well as by their scientific and industrial objectives.

Below are projects relating to AI. There are three kinds: the actions of the CNRS (The CNRS cooperating research groups —"Greco"— and the thematic research programs called ATP—Action Thématique Programmée), the National Projects (PN), and the Cooperative Research Projects (PRC).

The CNRS Project. From 1979 to 1982 an ATP-CNRS has encouraged public research in AI. It has benefited from additional aid from ADI and CNET. It is the only project specific to AI, but it has been provided with limited budgets (1 million to 1.5 million FF per year, i.e., between $100 and $150K). Another ATP should be created in 1985. Moreover, several CNRS Greco projects bring together teams whose work is based partially on AI: Greco Programmation, Greco C3, Greco Communication Parlée, and Greco Calcul Formel. These groups do not have sufficient funds to allow them to play any role other than that of a forum for discussions and meetings. However, the existence of such structures is important and could make it easier to obtain aids from the authorities. Recently, the Ministry of Research and Industry decided to support projects in the area of methods and languages and man-computer communication. This support will be managed by the Grecos Programmation and Communication Parlée.

The National Projects. While setting its policy in 1981, the French Ministry of Research and Industry launched the concept of electronic "filière" (the French expression for a whole mill). According to this concept, to be successful and competitive the French electronics industry should master all the technological ingredients, from basic technologies and components to the software products and end products incorporating hardware and software systems. In July 1982, a list of seven projects was drawn: VLSI/CAD tools, Software Engineering, CAD/CAM, Computer Aided Instruction, Automatic Translation, Display Hardware, and Basic Components. As one can guess from these titles, most of the topics relating to the fifth generation are included in the national projects and one can perceive some similarity with other national or international cooperative projects such as the Alvey program in Great Britain, the BMFT program in the Federal Republic of Germany, the European ESPRIT program, or the four projects of MCC in the United States. One can see that AI is a component of many national projects but

that there is not a specific AI project.

The Cooperative Research Projects. By construction, the National Projects are essentially technology transfer projects; for this reason it was felt necessary to complement them by long-range research initiatives. So, after the National Projects were opened in 1983, the main research organizations started several fundamental research cooperative projects. One objective is to gather around a common topic and common resources the many research groups, most often small and spread out, dealing with fifth generation issues. These projects are still in the preparatory stage, but one of them should deal with the various facets of AI. Participants in these projects should be the main research organizations such as CNRS, CNET, INRIA, universities and the larger industrial laboratories performing basic research (CGE, BULL).

Review of AI in France by Subject Area

In this section we briefly describe the state of the art in France for the different areas of AI. This short description is obviously incomplete and does not mention many interesting works.

First, we look at the areas relating to the methods and the tools for AI (reasoning models, proof methods, languages, specialized machines). Then we shall speak about the main application areas: first about expert systems; second (and in a very general way as we are not specialists in these domains) about linguistics, speech, and vision

Fundamental Methods: Reasoning Models, Proof Methods, Learning

In the domain of theoretical research relating to AI, the position of French teams is excellent. For instance, at the Colloquium on Automatic Proving CADE7 (Napa Valley, May 1984), eight of twenty-four papers were of French origin.

There is a French research school in the areas of Automatic Proving and Rewriting Rules that has built up strong international cooperations. Active teams are gathered around the FORMEL project (INRIA, LITP) and the EURECA Project (CRIN). The FORMEL team ports to various computers the ML Language, which is the metalanguage of the LCF system, and it takes part in the development of ML. It collaborates with the University of Cambridge (Great Britain) and other centers developing ML (University of Edinburgh and Bell Laboratories). The FORMEL project is oriented toward the use of ML as the metalanguage of a general system for manipulating formalisms, programming languages in particular. The EURECA team implements the REVE software, written in CLU, and cooperates with MIT, with the Laboratory of the General Electric Company at Schenectady, New York, and with the Laboratory of the CGE at Marcoussis in France. It also collaborates with SRI in the OBJ project, which proposes a programming language based on rewriting.

The reasoning models based on classical logic are well represented in France. The PROLOG language (GIA) based on the first order predicate logic is a world-famous success (see below). The mechanisms of unification and their improvements (for example, unification in an equational theory), the completion of rewriting systems, are subjects for very high level research in France. The nonclassical logics (nonmonotonic logic, temporal logic, fuzzy sets) are also the subject of active research in LSI, IRISA, and GRTC. In a different way, we must notice the remarkable success of the ALICE system (GR 22 of the CNRS, Paris 6) in reasoning by propagation of constraints. Finally, we must emphasize the French school in the difficult domain of learning, rather theoretical in LRI (synthesis of functions, techniques of generalization from examples), more applied, as in relation to robotics, in Toulouse (ENSEEIHT, LAAS) and Grenoble (LIFIA).

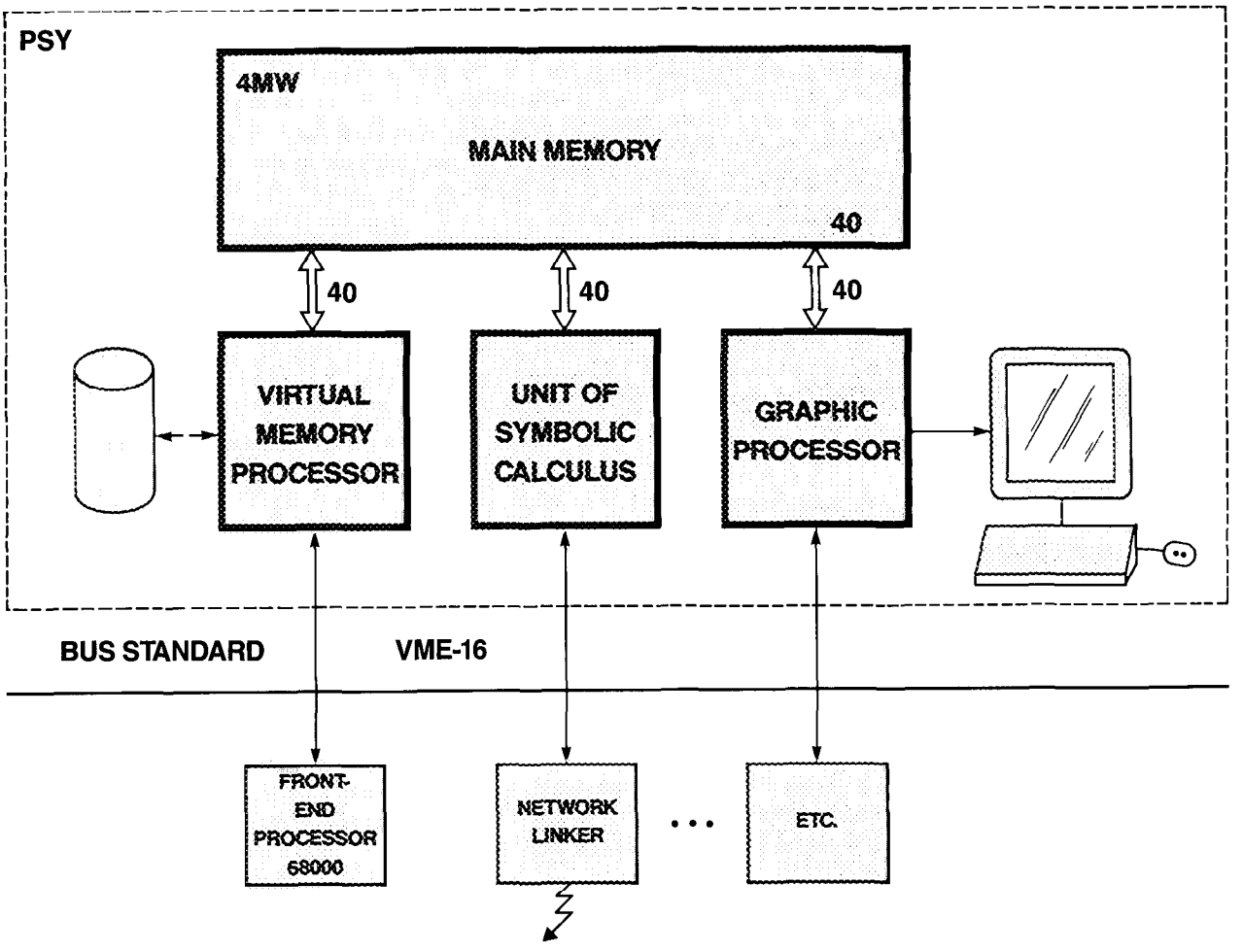
AI Languages

The most commonly used languages in France for AI are LISP and PROLOG, but there is an increasing interest for the object-oriented languages. The French school in LISP is original and strong. It is based on the work of the University of Vincennes (Paris 8), where VLISP has been realized. VLISP eliminates some terminal recursivities. It has been implemented on many machines, from the Z80 processor to the PDP10 computer, and its diffusion in France is quite extraordinary considering the means of its creative team. Its main inconvenience is that it is not (yet) compiled.

Another interesting realization is LELISP (INRIA). LELISP eliminates all the terminal recursivities. It is conceived on the virtual machine LLM3, which makes implementation on different computers easier. LELISP is compiled and it is targeted to have wide diffusion on the SM 90 computer (INRIA, CNET), the VAX, and other machines.

One of the most well-known French realizations in AI is the PROLOG language. The principle of resolution of J. A. Robinson—more precisely the strategy of negative resolution with HORN clauses—has inspired the GIA to design the PROLOG language (Programming in Logic). It has become the main tool for many AI teams and is now world-famous after having been included in the Japanese MITI's Fifth Generation Project. The PROLOG-2 version has been implemented on the Apple-II computer and thus is very widely used. The PROLOG-CNET version written in PASCAL is implemented on the SM 90.

Combinations of LISP and PROLOG have also been realized. LOVLISP (Paris 8) and LOGIS (Compiègne) are available on MacLisp and on the LMI LISP machine, and LISLOG (CNET-Lannion) and PROLISP (CERT) are both available in MacLisp and LELISP The ALOG system (ENSEEIHT) combines PROLOG and PLASMA, and it leads us



The architecture of the MAIA machine.

Figure 1.

to discuss the object-oriented languages.

An increasing number of AI researchers in our country show an increasing interest in these languages. After some implementations of PLASMA (Toulouse) and of SMALLTALK (LITP, Brest), new original languages have been developed at many places, such as FORMES (LITP), ULYSSE (CNET-Lannion) and MERING (Paris 6). Also, the problems of knowledge representation have led teams that were more specialized in expert systems to design object-oriented languages such as KOOL (BULL) and LRO (LIA).

AI Machines

The high level of the French LISP and PROLOG teams might imply that France is already well advanced in the area of machines specialized for AI. This is not the case. Certainly, the software available on the SM 90 makes this computer an acceptable tool for the AI researchers, but it is a computer with a relatively classical architecture.

Fortunately, it seems quite possible to make up the lost time. First, the M3L machine has been developed at Toulouse. The M3L is specialized to access and traverse trees and is thus well suited to write interpretors and compilors for LISP and PROLOG. A LISP interpretor has been written on the M3L, which runs faster than most American LISP machines. The M3L team is now working at CGE on the MAIA project.

MAIA is an ambitious project in which the CGE and the CNET are cooperating. This project is expected to provide, by 1985, machines that will run in LISP and PRO-

LOG, and that will be very competitive with the American machines. To the best of my knowledge, this project is the most ambitious in this domain in Europe.

We give below a short description of what the future MAIA machine will be, with the kind authorization of the CGE research center.

Architecture:

- MAIA is a single processor workstation that is autonomous, capable of multitasks, and has a large virtual memory. It has two main parts: the Symbolic Processor (PSY) and a standard Bus (VME).

Basic Software:

- The COMMON-LISP standard is the basis for the software environment of MAIA.

Hardware:

- The symbolic calculus unit extracts the instructions in advance. It is based on 40-bit words and is realized with TTL and IMOX technologies.
- The main memory manages words of 40 bits, a descriptor of 8 bits and 32 bits of value or address. It has from 1 to 4 megawords in 256K technology.
- The virtual memory processor manages a high-speed disk.
- The graphic display is a bit-map one.
- The standard BUS VME 16 bits allows connections of many peripheral devices.

Expert Systems

With some delay behind the United States, France is developing a passion for expert systems. The industrial demand is strong for applications of this technique, but is not always justified or lucid, which presents some risks that we have discussed above. Some public organizations such as the Ministry of Defense (DRET), want to explore the possible contributions of expert systems in their domain.

That leads us to initiate an important list (even if very far from being exhaustive) of expert systems dealing with various domains. However, we must mention that most of them are only prototypes and not real software products. They are listed below without significant order:

In medicine

SPHYINX and PROTIS (MARSEILLE-AIX) for the diagnosis of epigastric pains and for the treatment of diabetes.

In CAD

TROPIC and GARI (LIFIA) for the design of electric transformers and for process planning in manufacturing mechanical parts; COPEST (ENSET) for the design of fleeced mechanical parts.

In information retrieval

RESEDA (LISH) deals with a historical data base; EXPRIM (CRIN) with pictorial databases.

In civil engineering

CESSOL (LIA), which specifies site investigations for buildings; LEGO (CIMA) in architecture.

In geology and the oil industry

LITHO (Schlumberger), which determines lithofacies in oil drillings; SIMMIAS (Elf-Aquitaine) which deals with hydro-carbon transmigrations; SECOFOR (Elf-Aquitaine), which diagnoses the cause of sticking incidents during oil drilling and recommends treatment.

In breakdown diagnosis

For nuclear power stations (EDF); for analog electronic circuits (ESD); for nuclear boilers (CGE).

In archeology

Antique scenes analysis (LISH); the ARCHES system (GRTC).

In speech processing

SYSTEXP and MYRTILLE (CRIN) for acoustico-phonetic decoding; SERAC (CNET, IRISA) for continuous speech recognition.

In military applications (DRET, ESD, LIA)

Interpretation of radioelectric signals, interpretation of sonar signals, surveillance of a battlefield.

Besides many developments of expert systems for particular applications, one must emphasize research on knowledge representation (see Languages, above), and more especially on knowledge processing. In particular, several teams have developed inference engines that are relatively general and may be used for a large family of problems: SNARK (GR22), TANGO (LRI), GOSSEYN (ENSET), ALOUETTE (EDF), BOUM (BULL). The LRO Language and the EAQUE inference engine are the two main parts of a system developed at LIA to generate, experiment on, and refine expert systems in various domains. Rigorousness in expert system methodology is the principal concern of the French schools. All researchers are convinced of the importance of the study of basic methodologies such as coherence management and metaknowledge. This trend must be encouraged by supporting the projects that unite methodological considerations with the production of an effective expert system.

Computational Linguistics

In France, as everywhere, there is a dividing line between those (the linguists) who study natural language and those (the "informaticians") who use it for a specific purpose. One positive point is that the teams of linguists, often old and experimental, have a good knowledge of the automatic processing of the French language. There are many computerized realizations, such as "The Treasure of French Language," which inventory the different uses of each word. A rather complete model of French has been established according to the model of chained grammars

of Z. Harris. A translation of this model in PROLOG is being carried out.

On the other hand, the informaticians work on sublanguages and may be satisfied with rather crude syntactic models as they generally have to solve a very tiny part of the semantic and pragmatic problems. They can use algorithms (and some heuristics) to convert some sentences into sequences of actions. Typical applications are the query of data bases or the translation of technical texts in very specific domains. Research in natural language representation and understanding is very widespread; examples are GR22, LRI, LSI, CRIN. Work in speech processing is more and more concerned with problems of natural language. Thus, connections between these two domains are more and more frequent, e.g., the Greco Communication Parlée.

The French community working on the problems related to computational linguistics is not very well organized (which is somewhat natural as regards the wide variety of problems and approaches in this field). The recent creation of two associations, the ARC (Association pour La Recherche Cognitive) and the ATALA (Association pour Le Traitement Automatique des Langues) could improve this situation. Also, it is significant that the theme "Automatic Translation" has been selected among the National Projects. This project will greatly help to join the efforts in the area of Natural Language Automatic Processing. Considering the level of the research teams in this domain, we can expect promising results.

Automatic Speech Processing

France stands just behind the United States and Japan in this field. Cooperation between the research teams is fairly good, essentially through the CNRS Greco Communication Parlée.

Created in 1981 by six teams (CERFIA-Toulouse, CRIN-Nancy, CNET-Lannion, ENSERG-Grenoble, Institut de Phonetique-Aix, LIMSI-Orsay) the Greco Communication Parlée now includes 18 laboratories. Its role is to promote and coordinate the research in Automatic Speech Processing.

Five projects are being developed currently:

- Recording a database of French songs, including acoustic, articulatory and prosodic information. A part of this work is already done and should be implemented on the SM 90.
- Creating a lexical database of spoken French, taking into account morphologic and phonologic aspects. A preliminary version of this database, 8DLEX 0, is operational and available on Multics.
- Acoustic-phonetic methods for encoding and decoding continuous speech, which is a major problem in recognition and synthesis.
- Man-machine verbal dialog with the three complementary aspects of ergonomic evaluation, language level and architecture for a dialog system.
- Acoustic analysis of vocal signals, in relation with the database of sounds. A group has compiled all the available methods in order to standardize the process used by the different teams. Specifications and design of a quick processor for Signal Processing, well-suited to speech, are being investigated.

The Greco Communication Parlée is supported by the CNRS, the ADI, and the Ministry of Research and Industry. Among advanced realizations are SYSTEXP (CRIN), an expert system for phonetic decoding of sonograms, and the system MYRTILLE 2 (CRIN) for recognition and understanding of continuous speech.

Computer Vision

French research in computer vision is good at the theoretical level. France is present internationally in computer vision essentially through its universities, its great engineering schools, and the CNRS. The French government has not supported research as well as the Japanese and U.S. governments have, nor has industry played a very innovative role.

Two committees of ADI (Images and Robotique) could support research and realizations in computer vision, but they lack significant resources for doing it. Also, computer vision may obtain support by means of its connections with robotics (for example, the ARA project, which is well supported).

There are capable teams in France, mainly INRIA, Nancy (CNRIN), Toulouse (CERFIA), Grenoble (LIFIA), and the robotic group LAAS in Toulouse. They would be strengthened if gathered around common projects, but no structure for that exists at present.

Among realizations are the work of INRIA in modelization of geometric objects, and in 2-D and 3-D industrial scene analysis; the system CAIMAN (LIFIA) for extracting primitives; the system MIRABELLE (CRIN) for interpretation of drawings; and the system SASCO (CERFIA) for scene analysis and understanding.

Conclusion

The survey in the preceding section has exhibited strong points and great potentialities. In general, the theoretical level is good or very good, but the organization is more varied according to areas, and some structuring efforts have to be done. Also, the communication between research and industry must be amplified. Certainly, in our opinion, the best way to improve communication (between the researchers first, between research and industry second) would be the creation of large-scale AI projects (PN or PRC) supported by the authorities.

In spite of the difficulties and the various problems that are listed in the first section of the paper, we believe very strongly that AI research in France is still competitive. Perhaps in a few years that will not be true any more, but given the right impetus, France could play a more important role at the international level. It is essentially a question of politics. AI research in France lacks means, in personnel (and the problem of education must be emphasized), in material, and in structures, but it still holds important trump cards, especially as regards the high level of most research teams. If means follow, people can follow. Considering the importance of the economic stakes related to the development of AI, we remain optimistic.

Appendix

The names of most organizations significantly related to AI research in France are listed below. They may be laboratories, universities, public research organizations, private companies, or other institutions that play a role in the support of AI research.

The address of each organization is given and, when possible, its main areas of AI and the names of people that may be contacted are listed.

ADI: Agence de L'Informatique. Tour Fiat Cedex 16 75017 Paris *Public organization which plays a role in supporting transfers of technologies in electronics and informatics between research and industry.* (J.C. Rault)

BULL: Research Center (AI Dept). 60 route de Versailles - 78430 Louveciennes. *Languages, Machines, Expert Systems* (J. Rohmer).

CERFIA: Laboratory. See University Toulouse. *Language, Speech, Vision.* (S. Castan, G. Perennou).

CERT-ONERA: Centre d'Études et Recherches de Toulouse. 2 avenue E Belin - 31055 Toulouse. *Languages, Databases*

CGE: Compagnie Générale Electrique. Company/Research. Center Laboratory of Marcoussis - Route de Nozay - 91460 Marcoussis *Fundamental Methods, Languages, Machines, Expert Systems, Speech.* (G Guiho)

CNET: Public (Ministry des Postes et Télécommunications). Has two research centers See CNET-Lannion and CNET-Paris.

CNET-LANNION: Route de Tregastel - 22301 Lannion. *Languages, Machines, Expert Systems, Linguistics, Speech.* (F. Hautin).

CNET-PARIS: 38 rue du General Leclerc - 92131 ISSY-LES-MOULINEAUX. *Languages.* (G. Barberye).

CIMA: Centre d'Informatique et de Methodologie en Architecture Public 9 rue Barbanegre - 75019 Paris *Expert Systems* (C. Manago).

CIMSA: Compagnie d'Informatique Militaire Spatiale et Aeronautique. Company 10-12 avenue de L'Europe - BP. 44, 78140 Velizy. (L. D'Archimbaud).

CNRS: Centre National pour la Recherche Scientifique. The most important French public organization for research in all disciplines. See GR22, GRTC, LAAS, LISH

COGNITECH: Company (Software). 1 rue Jules Lefebvre, 75009 Paris. *Expert Systems.* (J. M. Truong NGOC).

CRIL: Conception et Réalisation Industrielles de Logiciels. Company (Software) 12 bis rue J. Jaures 92807 Puteaux. *Languages, Expert Systems.* (F. Simon).

CRIN: See University NANCY *Fundamental Methods, Expert Systems, Linguistics, Speech, Vision* (J P. Haton, J. M. Pierrel).

DRET: Direction des Recherches et Études Techniques (Ministry of Defense). Public 26 boulevard Victor 75996 Paris. (C H. Dominé).

EDF: Electricité de France Direction des Études et Recherches. 1 avenue du General de Gaulle, 92140 Clamart. *Expert Systems.* (M Gondran).

ELF-AQUITAINE: Company SNEAP avenue des Lilas, 64000 Pau. *Expert Systems.* (A. Perrot).

EN SEEIHT: École Nationale Supérieure d'Enseignement Technique. 61 avenue Wilson 94230 Cachan *Expert Systems in CAD/CAM.* (J. M. Fouet).

ENSET: École Nationale Supérieure des Télécommunications. 46 rue Barrault, 75013 Paris *Linguistics, Expert Systems.* (A. Bonnet).

ESD: Electronique Serge Dassault. Company. 55, quai Carnot, 92214 St Cloud. *Expert Systems.* (J. Perin).

FRAMENTEC: Company (Software). Monte Carlo Sun, 74 Boulevard d'Italie MC 980000 Monaco. *Expert Systems.* (A. Elkouby).

GIA: Laboratory. *Fundamental Methods, Language.* See University Marseille-Luminy.

GRTC: Laboratory of CNRS. 31 chemin Joseph Aiguier, 13042 Marseille. *Fundamental Methods, Expert Systems.* (E. Chouraqui).

GR22: Laboratory of CNRS Institut de Programmation. University of Paris 6, 4, place Jussieu, 75230 Paris. *Fundamental Methods, Expert Systems, Linguistics* (J. Pitrat, J. L. Lauriere, G. Sabah).

INRIA: Institut National de Recherche en Informatique et Automatique Public. *Fundamental Methods, Languages, Machines, Vision* (G. Huet, J. Chailloux, O. Faugeras).

IRISA: Institut de Recherche en Informatique et Systèmes Aleatoires. Public (depends on INRIA and CNRS). Campus de Beaulieu, 35042 Rennes *Fundamental Methods, Languages, Expert Systems, Linguistics, Speech.* (L. Trilling).

ITMI: Industrie et Technologie de La Machine Intelligente. Company. Chemin des Clos ZIRST, 38240 Meylan. *Expert Systems, Vision, Robotics* (B. Dufay).

LAAS: Laboratory of CNRS and University of Toulouse. 7, avenue du Colonel Roche 31400 Toulouse. *Robotics, Expert Systems, Vision.* (C. Giralt).

LIA: Laboratory. See University Chambery. *Languages, Expert Systems* (J. P. Laurent)

LIFIA: Laboratory. See University Grenoble. *Fundamental Methods, Languages, Expert Systems, Vision.* (Latombe).

LIMSI: Laboratory. See University Paris 11. *Speech.* (J. Mariani)

LISM: Laboratory of CNRS 54, boulevard Raspail, 75270 Paris. *Expert Systems, Linguistics.* (G Zarri).

LITP: Laboratory. See University Paris 7. *Fundamental Methods, Language.* (G. Cousineau).

LRI: Laboratory See University Paris 11. *Fundamental Methods, Languages, Expert Systems, Linguistics* (Y. Kodratof, M O. Cordier, D. Kayser).

LSI: Laboratory. See University Toulouse *Fundamental Methods, Languages, Machines, Expert Systems, Linguistics, Vision.* (M. Borillo, J. Virbel).

PROLOGIA: Company. 278, rue Saint-Pierre, 13005 Marseille *Language* (A. Colmerauer).

SCHLUMBERGER-FRANCE: Company. Études et Productions Schlumberger. 26, rue de Language Cavée 92140 Clamart. *Expert Systems.*

University of BREST: Université de Bretagne Occidentale. Département de Maths et Informatique. 6, avenue Victor Le Gorgen, 29283 BREST *Language* (J. Bezivin).

University of CHAMBERY: Université de Chambery. BP 1104, 7301 Chambery. See LIA.

University of COMPIÈGNE: Université Technologique de Compiègne BP 233, 60206 Compiègne. *Language* (P Gloess).

University of GRENOBLE 1: Université Scientifique et Médicale de Grenoble et Institut National Polytechnique de Grenoble. Domaine de St Martin d'Heres 38041 Grenoble See LIFIA.

University of MARSEILLE-AIX: Faculté de Médecine 27, boulevard Jean Moulin 13385 Marseille. *Expert Systems in Medicine.* (M. Fieschi).

University of MARSEILLE-LUMINY: UER Scientifique de Luminy, 70 route Leon Lachamp 13288 Marseille. See GIA.

University of NANCY 1: BP 239 S4506 Vandoeuvre-Les- Nancy. See CRIN.

University of PARIS 6: Institut de Programmation. 4, Place Jussieu, 75230 Paris See GR22.

University of PARIS 7: Laboratoire d'Informatique Théorique et Pratique. 4 place Jussieu, 75230 Paris. See LITP.

University of PARIS 8 (VINCENNES): 2, rue de Language Liberté 93526 St Denis. *Fundamental Methods, Language.* (P. Greussay).

University of PARIS 11 (ORSAY): Université de Paris-Sud. 91405 Orsay. See LRI, LIMSI

University of RENNES 1: Campus de Beaulieu 35042 Rennes. See IRISA.

University of TOULOUSE: Université Paul Sabatier. 118, route de Narbonne 31062 Toulouse. See CERFIA, ENSEEIHT, LSI

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