ESPRIT, THE EUROPEAN STRATEGIC PROGRAMME FOR RESEARCH AND DEVELOPMENT IN INFORMATION TECHNOLOGY

The communications from several of the panelists concerned the ESPRIT program, which could not fairly be represented in the short time allotted to the panel discussion. Included here are some comments from Patrick van Hove, the head of the ESPRIT program, an outline of the program, the motivation for the program, and a brief description of each of the many projects funded by the program.

ESPRIT COMPARED TO THE DARPA PROGRAM, FROM VAN HOVE

Van Hove sees major differences between DARPA and ESPRIT as follows. The overall objectives of ESPRIT are civilian and oriented towards the industrial sector. The cliche of a successful ESPRIT project is one which will lead, after its completion, to the development of successful commercial products by the industrial participants in the project.

At the level of individual projects, each ESPRIT project is contracted to a consortium of organisations, with a minimum of two partners from different member states; projects are typically contracted to 4 to 8 partners. A major difference for the participants is also that the Community supports 50% of the project budget, as opposed to 100% with DARPA. The other 50% contributions come from the organisations themselves and somehow guarantee that the project is of genuine interest to the industrial organisations involved. At the end of the project, the property rights remain with the project participants. Eligibility for participation in an ESPRIT project requires that the organisation be incorporated in one of the 12 member states, namely Belgium, Denmark, Germany, Greece, France, Italy, Ireland, Luxemburg, the Netherlands, Portugal, Spain, and the United Kingdom. The participation has also been extended to organisations incorporated in one of the "EFTA countries", namely Austria, Finland, Iceland, Norway, Sweden, Switzerland; however, in that case, the Community does not contribute to the costs of the EFTA organisation(s).

OVERVIEW OF THE ESPRIT PROGRAMME

The following material is taken from the Information Package for Proposers, 1989. ESPRIT, the European Strategic Programme for Research and Development in Information Technology, has the following objectives:

- To provide European industry with the basic technologies to meet the competitive requirements of the 1990s.

- To promote European industrial cooperation in precompetitive R&D in information technology (IT).

- To pave the way for internationally accepted standards.

ESPRIT addresses three major IT sectors:

- Microelectronics

to improve the technological capabilities of the microelectronics sector and to strengthen its interaction with the microelectronics users sector so as to enable Community IT industry as a whole to draw maximum benefits from state-of-the-art semiconductor technology.

- Information Processing Systems

to bring together tools and technologies for hardware and software domains required to meet the competitive requirements of the 1990s. Special emphasis will be put on systems design technology, parallel computer architectures and knowledge engineering.

- Applications

to improve the ability to use and integrate IT, and to encourage rapid transfer of IT innovations to selected areas of applications. Special emphasis will be put on computer integrated manufacturing and on office an business systems.

ESPRIT is implemented through pre-competitive R&D projects. The topics which projects address are described in the ESPRIT Workprogramme, which also describes the strategy, objectives and technical aspects of the work of the programme. The Workprogramme is updated regularly in consultation with the European IT community. Calls for Proposals are published in the Official Journal of the European Communities.

ESPRIT projects are carried out under shared-costs contracts by consortia which must include at least two industrial partners from different Member States of the Community. In addition to industrial R&D projects, the programme includes actions in Basic Research.

THE MOTIVATION FOR THE ESPRIT PROGRAMME

The following material is taken from European File, "ESPRIT: key to the technological awakening of Europe." In seizing the opportunities offered by information technology, Europe was initially handicapped by its own inherited structures. The problem was not any lack of scientific and technological skills, but the partitioning of the market into distinct national entities, so that potential was also fragmented. European industry could not achieve a 'critical mass' and benefit from the same economies of scale as its direct competitors - American, Japanese and, more recently, South-East Asian industry. Although its own internal market represents a substantial segment of world demand, the European electronics industry has lost considerable ground over the past decade. In 1975, the Community had a positive balance of trade in information technology, amounting to some ECU 1.7 billion. Since then, however, it has been in the red, with a deficit of almost ECU 22 billion in 1988.

Only a far-reaching, Community-level initiative could halt this deterioration. It was a question of accepting an economic challenge of vital importance for Europe - and of ensuring the continent's independence in making the technological choices for its future, in an area which influences the entire development of society. From the start of the 1980s, the Commission of the European Communities therefore undertook, in close consultation with industries in this sector, and with scientific circles and the national authorities of the Member States, an assessment of the particular handicaps to be overcome and the action to be taken. The following points emerged:

- The necessity to combat the scattering of research and development efforts, by strengthening in particular cooperation between industry and the universities.

- The need for a new European dimension, to be achieved by widening the market (notably by ending the old reflex of 'national preferences'), but also by seeking a larger optimal size for competitive companies and therefore a rationalization of the sector.

This is the context in which Esprit was born. Following a short pilot phase, the programme was effectively launched in February 1984 for a 10•year period. Designed to mobilize both Community and private resources on a larger scale, it has three basic objectives:

- To promote cooperation in the information technology field between industries, universities and European research bodies, on research and development projects up to pre-competitive level (prior to the development of commercial products).

- To provide European industry with the basic technologies necessary to meet the competitive requirements of the international market in the 1990s.

- To contribute to the development and international recognition of technical standards essential for the development of information technology.

The core of the Esprit programme is a work programme which established an overall framework as well as various objectives in the main basic areas of information technology. The programme enables research and development projects to be carried out, involving at least two industrial concerns from two different Member states, with or without participation of one or more universities or research institutes.

- The Esprit workprogramme, which is revised and adjusted annually, is drawn up following consultation and dialogue with several hundred experts of different backgrounds. This approach enables the European Commission to identify the lines of action corresponding to the needs actually expressed by industrialists and scientists.

- The Commission then proceeds each year with a public 'call for proposals'. The would-be participants define, in complete independence, the aims, scope and methods of their research. The projects, which are selected on the basis of an assessment by a group of independent experts, are supported financially by the

Community. The Community is responsible for half the agreed costs, the other half is supplied by the participants themselves.

ESPRIT SYNOPSES

This section contains a brief report on each of the ESPRIT projects.

Integration and Design of Speech Understanding Interfaces (SUNSTAR)

Objectives and Approach. The objective of SUNSTAR is to show the benefits and enhancements that human computer interfaces can offer when they are based on speech input/output. The project will demonstrate this by realising prototypes in two fields of speech application which represent market sectors of rapidly growing importance:

- a professional, office-type environment

- a public telephone network environment.

The project is application-driven in the sense that it concentrates on the integration of speech functions into demonstrator systems rather than on fundamental research issues of speech recognition and speech output.

Dialogue design and the associated ergonomic aspects are of high importance to the project, in order to gain wider acceptability for speech interfaces in real-world applications. Another key issue is the integration of speech technology with other input/output devices.

Exploitation. The SUNSTAR project concentrates primarily on the integration of existing technologies; the first industrial products and services are expected to emerge from work in this project during 1992.

Contact Point: Dr. Joachim Irion, AEG OLYMPIA AG, Max-Stromeyerstr. 160, D - 7750 KONSTANZ
Tel: + 49/ 7531-818559
Fax: + 49/ 7531-818500
Tlx: 733233
Participants: AEG OLYMPIA AG, TELEFONICA INVESTIGACION Y DESARROLLO, ALCATEL FACE STANDARD SPA, FRAUNHOFER-IPA, JYDSK TELEFON (JTAS), UNIVERSITAT STUTTGART

Adverse-Environment Recognition of Speech (ARS)

Objectives and Approach. The objective of ARS is to develop improved algorithms for speech recognition in the presence of noise, and to build a real-time demonstrator. The demonstrator will verify algorithm performance and address the problem of speech-based man-machine dialogue as a system interface in practical applications.

Two application environments have been chosen, namely vehicles and factories. The system will have a vocabulary in the order of 100-500 words, chosen by each national group of partners and tailored to the specific application environment.

Advances will be made in:

- reduction of the effects of noise on speech signals by signal preprocessing

- feature extraction aimed to improve noise robustness

- study and refinement of algorithms for speech pattern matching in noisy environments

- speaker adaptation

- dynamic system adjustment to user feedback and the development of error correction strategies in the human interface

- development of system prototypes (hardware and firmware) for real-time speech recognition.

The real-time demonstrator will be based on a general-purpose DSP chip attached to a personal computer or a stand-alone system. In the development system, the signal processor will be connected to a host which will provide for development support of software algorithms and for file-server function to the databases required. Performance evaluations will first be made in the laboratory using suitable databases collected in noisy environments and by measuring the resulting rate of correct recognition. Performance under field conditions will then be assessed from a prototype fitted in a vehicle and a laboratory system installed in a factory.

The project will liaise with DRIVE research programme projects dealing with vehicle applications, and with other European projects on speech recognition.

Progress and Results. After the first year of the project, a multilingual database collected in noisy environments was made available among the partners and was used for the evaluation of their baseline systems. These baseline systems were realised according to a common standard suitable for exchanging the software modules of the algorithms (studies of which are presently in progress) among partners.

The hardware structure of the final real-time demonstrator has been defined.

Exploitation. The results of the project will find application in:

- adding the facility of voice commands to the mobile radio terminal that the partner companies and their affiliates are manufacturing or marketing (Italtel, Matra Communications, Page Iberica, etc)

- easing the introduction of such a facility by the operating companies (e.g., SIP) in the use of mobile telephones for cars

- enhancing existing voice-operated quality-control systems in vehicle manufacturing (e.g., Logica)

- enhancing existing real-time continuous speech recognition products (e.g., Logica SDS).

Contact Point: Mr. G. Babini, CSELT, Via G. Reiss Romoli 274, I - 10148 TORINO
Tel: + 39/ 11-2169391
Fax: + 39/ 11-2169520
Tlx: 220539 CSELT I
Participants:, CSELT-CENTRO STUDI E LABORATORI TELECOMUNICAZIONI, TELECOM PARIS, MATRA COMMUNICATION, UNIVERSITY OF CAMBRIDGE, UNIVERSIDAD POLITECNICA DE MADRID, UNIVERSITY OF KEELE, PAGE IBERICA SA, LOGICA LTD, LOGICA SDS LTD, POLITECNICO DI TORINO

Multi-Language Speech-to-Text and Text-to-Speech System (POLYGLOT)

Objectives and Approach. The goal of POLYGLOT is to demonstrate the feasibility of multi-language voice input/output for a number of commercially promising applications. The objective is to integrate phonetic, lexical, and syntactic knowledge common to text-to-speech and speech-to-text conversion, providing greater generality, lower cost, and easier extensions.

A set of technologies and working prototypes is planned:

- Very large vocabulary (tens of thousands of words), isolated words, speaker-adaptive speech recognition on a PC, for speech-to-text conversion in six European languages, will be implemented and tested. Continuous speech recognition will be addressed as well, but only to the stage of producing a strategy for implementation on a PC.

- High quality, language-sensitive, unrestricted vocabulary, text-to-speech conversion in six European languages.

- Tools for easy extension of both the recognition and synthesis technologies to additional languages.

- Application development tools for recognition and synthesis.

- Development of demonstrators for language teaching, voice feedback for a blind typist, remote access to an electronic mailbox, access to a mail directory, and natural language access to a database.

The project is based on the results of ESPRIT project 860. An existing isolated-word speech recognition system which was developed by one of the partners will be extended, under this project, to six other languages.

Progress and Results. Detailed speech database specifications have been completed for isolated word recognition, continuous speech recognition and text-to-speech. Full specifications of the POLYGLOT common hardware and software are also available. A tool for the acquisition and hand segmentation or labelling of speech, SAMBA, has been implemented on a PC. A modular architecture for "time delay neural networks" has also been completed.

The first half-year's work on text-to-speech has mainly been preparatory and theoretical in nature. However, specifications of the following are now available: system

36

architecture; automatic language identification; voice source and vocal tract model; analysis and development tools; prosody and intonation; working environment for synthesis rule development.

Exploitation. So far, the acceptance of speech recognition and synthesis systems on the market has been marginal due to unsatisfactory performance, high purchase costs, and the lack of application development tools. The project aims to establish the technology for a wide variety of modular, multi-lingual, speech input/output systems, mostly based on personal computers. Such a range of applications promises a high-volume market for products aimed at end-users and small system houses. These systems are believed to provide an important contribution to the development of market demand for an even wider range of speech technology products.

Contact Point: Mr. V. ING. C. OLIVETTI & C. SPA,
Corso Svizzera 185, I - 10149 TORINO
Tel: + 39/ 11-748162
Fax: + 39/ 11-746511
Tlx: 210030
Participants: ING. C. OLIVETTI & C. SPA, BULL SA, PHILIPS KOMMUNIKATIONS INDUSTRIE AG, TA-TRIUMPH-ADLER AG, UNIVERSITY OF PATRAS, UNIVERSIDAD POLITECNICA DE MADRID, RUHR-UNIVERSITAET BOCHUM, CENTRE FOR SPEECH TECHNOLOGY RESEARCH, KATHOLIEKE UNIVERSITEIT NIJMEGEN, NEDERLANDSE PHILIPS BEDRIJVEN BV, CNRS-LIMSI

Speech Understanding and Dialogue (SUNDIAL)

Objectives and Approach. SUNDIAL addresses the problem of speech-based cooperative dialogue as an interface for computer applications in the information services domain. The main technologies to be developed will be continuous speech recognition and understanding, and oral dialogue modelling and management.

Speech input will be sentences of naturally spoken utterances of telephone quality with a vocabulary of the order of 1000-2000 words for each of the applications. The grammar will be based on a subset of the four partners' languages (English, French, German and Italian). The project has commenced with speaker-independent recognition of sub-word units; however, the second phase will consider automatic on-line speaker adaptation with a view to improving performance. The dialogue manager will allow users to express themselves in a restricted natural language.

Prototypes will demonstrate the technology for three main information service applications: intercity train timetables (German), flight enquiries and reservations (English and French) and a hotel database (Italian). The spoken language phenomena to be covered will be determined from analysis of both human-human corpora of dialogues as well as human-machine simulations. Each demonstration system will be evaluated through extensive user trials.

For all demonstrators, the project has to define a common general architecture, common formalisms for grammar representation across languages, and common semantic representations for dialogue management and message generation.

Progress and Results. The project started with a number of definition studies for the general architecture and studies of application scenarios. A common architecture has been defined, together with the interfaces between the major modules; this will facilitate comparative evaluation and exchange between partners.

A small vocabulary for the telephone speaker-independent recogniser has been developed with a vocabulary of 50 words, suitable for a banking-by-phone application. Tests on the recogniser using the Recogniser Sensitivity Analysis (RSA) technique (being developed in project 2589, SAM - see page 106) have shown 95.6% correct recognition (+/- 0.7% at the 95% confidence level) on the RSA 31-word vocabulary.

Preliminary results for the acoustic-phonetic decoding module show that continuous density HMMs (CDHMM) achieve 77.6% word accuracy on sentences compared to 68.5% for discrete density HMMs using 275 phonetic units for the Italian language and a near 1000-word vocabulary. These results are for speaker-independent recognition of telephone quality sentences, but do not take into account the effect of the linguistic processing module on sentence understanding performance.

Results for the English language using CDHMM show that phoneme recognition accuracy on the DARPA TIMIT database is comparable to that achieved by Kai-Fu Lee in the Carnegie Mellon SPHINX system.

A common dialogue manager architecture has been defined and work is in progress on its implementation.

The first full working prototype oral dialogue system is on target for completion by July 1991.

Exploitation. SUNDIAL is targeted at natural-language oral dialogues, particularly for information services. This technology will find its prime application in telephone-based services, i.e. when other terminals are not available. Applications range from business-related services (e.g. calling the company computer through a telephone), to services aimed at the general user, such as banking-by-phone, which is now becoming quite common in Europe. Most of these applications are currently dominated by technology from the USA. One of the partners is already planning early exploitation of the isolated-word speaker-independent recognition work in applications such as telephone banking and mail order; this represents a major advance for European industry in providing a home-grown source for the technology.

Contact Point: Mr. Jeremy Peckham, LOGICA LTD, Betjeman House, 104 Hills Road
UK - CAMBRIDGE CB2 1LQ
Tel: + 44/ 223-66343
Fax: + 44/ 223-322315
Participants: LOGICA LTD, AEG AKTIENGESELLSCHAFT, CNET-CENTRE NATIONAL D'ETUDES DES TELECOMUNICATIONS, SARITEL-SARIN TELEMATICA, UNIVERSITAET ERLANGEN-

NUERNBERG, POLITECNICO DI TORINO, SIEMENS AG, IRISA-RENNES, CSELT-CENTRO STUDI E LABORATORI TELECOMUNICAZIONI, CAP GEMINI INNOVATION, UNIVERSITY OF SURREY

Multilingual Speech Input/Output Assessment, Methodology and Standardisation (SAM)

Objectives and Approach. The objective of SAM is to develop methodologies, tools and databases for the assessment of speech synthesis and recognition systems in application where multilingual performance is required from the same basic equipment. The consortium is necessarily broad, with participants from six EC and two EFTA member states. The project is thus able to provide techniques for assessing speech synthesisers and recognisers for at least the eight languages of the participating countries.

The participation of a large range of organisations also ensures that the final recommendations will be widely adopted. Furthermore, close ties have been established with related national projects in the participating countries, all of which are moving towards the use of SAM standards.

During a definition phase of this project, supported under ESPRIT project 1541, a first multilingual speech database was established on CD-ROM, and this continues to be widely used for the purposes of assessment, analysis and research.

Progress and Results. The activities in the present, main phase of the project focus around three major areas:

- Speech Input assessment: including the setting up of tests, their scoring, and the delineation of performance factors; for example, recogniser tests have been defined and run on the project's standard PC-based workstations, SESAM, using standardised scoring software. Cross-language work is also being directed towards the definition of recogniser sensitive speech dimensions.

- Speech Output assessment: both objective and subjective, including for example, standard multi-language tests for evaluation at the segment and suprasegmental level that have been developed to run on the workstation, using automatic response-scoring procedures, together with overall quality measures.

- Enabling Technologies: the specification of speech databases across all the project languages; the definition of uniform protocols for collection and management of speech databases in a standard format and the introduction of agreed methods for multi-lingual annotation are all examples of work in this area. The European SESAM workstation has been provided with tools for speech labelling, analysis and I/O assessment, and is already in use. Basic speech knowledge at the physical, phonetic and phonological levels is being organised for the languages of the project.

Exploitation. The assessment methods developed within this project will lead to the establishment of European standards. The SAM project will liaise with all other ESPRIT II speech projects and offers the implemented assessment methods for speech I/O to all other ESPRIT projects involved in the development of speech technology systems. Contacts and data exchanges established with organisations outside Europe, particularly the USA, make it appear likely that acceptance may be propagated on an even wider scale.

Contact Point:
Prof. A. Fourcin, UNIVERSITY COLLEGE LONDON, Wolfson House, 4 Stephenson Way, UK - LONDON NW1 2HE
Tel: + 44/ 71-3871055
Fax: + 44/ 71-383-0752
Participants: UNIVERSITY COLLEGE LONDON, AEG AKTIENGESELLSCHAFT, CRIN-ADILOR, CSELT-CENTRO STUDI E LABORATORI TELECOMUNICAZIONI, TNO NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC RESEARCH, TELEVERKET, ELAB-UNIT, JYDSK TELEFON (JTAS), PTT RESEARCH NEHER LABORATORIES, NATIONAL PHYSICAL LABORATORY, SMITHS INDUSTRIES AEROSPACE & DEFENCE SYSTEMS, RUHR-UNIVERSITAET BOCHUM, UNIVERSITAET BIELEFELD, THE ROYAL INSTITUTE OF TECHNOLOGY, ROYAL SIGNAL & RADAR ESTABLISHMENT, LOGICA LTD

Interactive System for Spoken European Language Training (SPELL)

Objectives. The aim of the SPELL project is to analyse the speech characteristics of non-native speakers and to develop tools to improve their spoken language skills.

As well as facilitating human communication, these tools will improve the usability of speech input/output (I/O) systems. Since advances in the development of robust speech I/O systems capable of accepting input from non-native speakers are unlikely to be developed in the foreseeable future, the project will concentrate on modifying the user's speaking habits (pronunciation, prosody, etc.).

Research topics will include phonetic analysis, phonetic distance metrics, multilingual systems, linguistics and computer-aided instruction. The languages involved are English, French and Italian; they will be analysed in order to extract their phonetic characteristics. The objective of the project is to conduct a feasibility study resulting in a demonstrator system able to process the voice of non-native speakers in order to identify and correct pronunciation errors. It will guide the user through a set of examples which gradually improve his or her pronunciation.

Contact Point: Mr. Jean-Paul Lefevre, OROS SA, Chemin des Pres 13 -ZIRST, F - 38241 MEYLAN
Tel: + 33/ 76-906236
Fax: + 33/ 76-905137
Tlx: 980490 F
ParticaOPOLIS CSATA NOVUS ORTUS

Pragmatic-Based Language Understanding System (PLUS)

Objectives. PLUS aims to achieve robustness in natural language understanding by treating natural language as a communicative activity whose essential characteristic is

38

to convey a meaning that is both appropriate and contextually relevant.

Since the intention of a human user of natural language is to convey a message, and since all messages occur in some context, it is crucially important to exploit this context in the derivation of the intended interpretation. This contrasts with other approaches to the problem of robustness, which can be classified as low-level (spelling correctors, online lexical acquisition, domain-dependent constraints, semantic grammars, and so on). These low-level techniques miss the heart of the problem, which is to react appropriately in a context created or updated by the fact that a user has typed something at a keyboard with the express purpose of communicating a message.

The key issue will be the exploitation of both pragmatic and linguistic phenomena (such as interpretation with respect to context and inference tools derived from non-linguistic problems) in order to provide reasoning-based robustness in natural language understanding by integrating these two areas. The consortium believe this to be the most important neglected area in current work on natural language understanding.

The development work to be carried out in the PLUS project will produce an environment for developing intelligent natural language interfaces to interactive computing environments (both information-seeking dialogue systems and problem-solving environments). A first demonstrator, interactive Yellow Pages, will be developed, but the modular architecture with a replaceable application model will enable new applications to be produced with relatively little effort.

The emphasis on the primacy of pragmatics and language-independent reasoning, and the resulting simplification of the language-specific knowledge-bases, will also facilitate the adaptation of the system to new languages or multilingual use. In the first development phase, development of both English and French interfaces to the test application are scheduled; as part of their work in the second phase on marketability, the industrial partners from other language communities will begin research on their own languages.

Contact Point: Dr. Jean-Marie Lancel, CAP GEMINI INNOVATION, Rue de Tocqueville 118, F - 75017 PARIS
Tel: + 33/ 1-40546637
Fax: + 33/ 1-42674139
Participants: CAP GEMINI INNOVATION, OMEGA GENERATION, PHILIPS RESEARCH LABORATORIES UK, SCS INFORMATIONSTECHNIK GMBH, ITK-KATHOLIEKE UNIVERSITEIT BRABANT, UNIVERSITY OF BRISTOL, UMIST, UNIVERSITY OF GOTEBORG (IVF), CNRS-LIMSI

The Multi-Purpose Standard Lexicon (MULTILEX)

Objectives. There is a need for a universal, standardised lexicographic format and a number of software conversion packages, leading to general re-usability of lexical resources, existing or under development, in a variety of applications including publishing, machine translation,

optical character recognition, speech recognition and information retrieval.

The project will take into account the results of current activities, including the EUROTRA-7 study, and avoid duplication with other parallel projects.

It will be executed in six consecutive phases:

- investigation of existing text corpora, lexical and terminological resources, software tools for the handling of these resources, and proposed formats and standards

- study of the impact of multiple linguistic theories and applications on the optimal lexical format

- definition of an optimal lexical format and a proposed standard for conversion tools

- deveal format and proposed standard

- studaources for a variety of uses

- deveamulti-purpose lexicons.

The project will cover seven Community languages: English, French, German, Italian, Spanish, Dutch and Greek.

Contact Point: Dr. Gerhard Heyer, TA-TRIUMPH-ADLER AG, Fuerther Str. 212, D - 8500 NURNBERG 80
Tel: + 49/ 911-3226088
Fax: + 49/ 911-3226282
Participants: OLIVETTI SYSTEMS & NETWORKS SRL, L-CUBE INFORMATION SYSTEMS SA, TA-TRIUMPH-ADLER AG, UNIVERSITY OF SURREY, SIEMENS AG, FRAUNHOFER INSTITUTE IAO, RUHR-UNIVERSITAET BOCHUM

A merger with the STEM proposal consortium is under discussion. The STEM consortium members are: CAP SESA INNOVATION, INK, LEXICON SRL, NEDERLANDSE PHILIPS BEDRIJVEN BV, GETA, IRIT, UNIVERSITA DI PISA, UNIVERSITA DI SALERNO, UNIVERSITE DE PARIS VII, UNIVERSITY OF MANCHESTER, VRIJE UNIVERSITEIT AMSTERDAM

European Multilingual Information Retrieval (EMIR)

Objectives. EMIR is a project undertaken by industrial firms and research laboratories specialising in both natural language processing and textual information retrieval.

The project consortium will complete a feasibility study into the automatic indexing of free text and the multilingual querying of text databases. The final goal is to give the user the opportunity to query in their own language text databases in different language, or to query in one language databases texts in several languages.

The resolution of such problems is particularly important for managing and accessing information in Community countries. At the end of the study, tools and utilities designed for such purposes will have been embodied in a demonstration prototype. The partners will use existing tools to carry out such tasks as automatic indexing (based on

statistical methods and using a linguistic treatment which employs morphological and syntactic analysis). The automatic indexing method produces, as part of the formatted database, a statistical model which can be used during the query-answering phase to sort documents according to a relevance hierarchy. Monolingual queries in natural language can use a reformulation expert system which has a large vocabulary at its disposal.

To prove the general character of the method, the consortium intends to start with an existing English/French prototype and extend it to an English/German pair which requires the development of an analyser for German. The French/German pair will follow, resulting in a trilingual query system. Methods and tools could then be applied to other languages. Multilingual text databases will be employed.

Contact Point: Mr. Christian Fluhr, CEA-COMMISSARIAT A L'ENERGIE, ATOMIQUE, CEN/SACLAY, F - 91191 GIF/YVETTE
Tel: + 33/ 1-69.08.63.11
Fax: + 33/ 1-69.08.79.93
Tlx: 604641 F ENERG X
Participants: CEA-COMMISSARIAT A L'ENERGIE ATOMIQUE, SYSTEX, UNIVERSITE DE LIEGE, TRANSMODUL

KNOWLEDGE ACQUISITION FOR NORMATIVE REASONING SYSTEMS (NOMOS)

Objectives. The NOMOS project is devoted to the development of tools for knowledge acquisition and reasoning for applications in the normative field. The validity of the tools to be developed will be tested through demonstration prototypes of specific applications.

The system includes the following environments:

- An acquisition tool, NKAT (Normative Knowledge Acquisition Tool), which is intended to support a knowledge engineer in the formalisation of normative texts. The approach to be taken in developing this component will include linguistic analysis on selected portions of the text and topic identifications, aiming at a text formalisation suitable for the inference engine; the requirements of retrieval systems based on such a formalisation will also be considered.

- An inference engine, NINFE (Normative INFerence Engine), which is devoted to normative reasoning. This component will have to manage the operators included in the formalisation language, and will make use of heuristics to suggest the most promising paths.

A Knowledge Representation Language (KRL) will be defined based on the specific requirements of the normative fields. In particular, one of the latest approaches to KRL (e.g., hybrid systems) will be taken as a basis and augmented with normative elements resulting from an analysis of normative texts.

The applications are expert systems (a normative expert system for French and Italian) in the normative area; these will produce legal advice and suggestions when fed with

specific cases. Starting from the specification of a "case", NINFE will deduce the relevant consequences of a set of formalised norms, with these norms extracted from the normative texts using NKAT. Furthermore, a Text Retrieval study on System (TRS) will be undertaken in order to demonstrate that NKAT is also suitable for applications different from expert systems.

The major result of the project should come from NKAT, namely the provision of a tool which will significantly help the task of engineering the knowledge of normative texts. Given the high cost of this task, and even though a high level of involvement by a human expert will still be required, this tool will represent a major advance in the development of knowledge-based applications, as well as applications of text retrieval, in the normative field.

The demand for knowledge-based applications in the normative field has been growing strongly over the past few years, and most partners in the consortium will exploit the outcomes of the project in this area. On the other hand, the reuse of the results of the project (in particular, NKAT) in other fields apart from the normative one is envisaged by some of the partners.

Contact Point: Mr. Enrico Pesce, SOGEI SPA, Via Cornello Celso 4, I - 00161 ROMA
Tel: + 39/ 6-8841101
Fax: + 39/ 6-4402686
Tlx: 621134
Participants: SOGEI-SOCIETA GENERALE D'INFORMATICA SPA, AXON-INST.DE INFORM.NORMATIVA AVANCADA, HELLASLEX, STEP-INFORMATIQUE, CNR-IDG, IRETIJ, TECSIEL SPA, INESC-INSTITUTO DE ENGENHARIA DE SISTEMAS E COMPUTADORES

ROBUST ANALYTICAL SPEECH RECOGNITION SYSTEM (ROARS)

Objectives. The goal of the ROARS project is to increase the robustness of an existing analytical speech recognition system (i.e., one using knowledge about syllables, phonemes and phonetic features), and to use it as part of a speech understanding system with connected words and dialogue capability. This system will be evaluated for a specific application in two European languages.

The work will start from an existing system implemented for the French language. This system has been shown to operate in real time, is speaker-independent, and has had satisfactory results with continuously uttered connected words. The aim of the first phase of the project is to develop and implement the corresponding knowledge-bases for the Spanish language and to enhance the robustness of this system against:

- intra- and inter-speaker changes in articulation, by the improvement of knowledge used in the system, including the possibility of a progressive and slow automatic adaptation

- various ambient noises, by analysing the degradations induced on each feature and rules used in the phonemic recognition system and the changes in articulation (at the feature level) when the speaker is in different noise

conditions; examining the problem of false alarms at the sentence detection level; and studying and testing improvements aiming to minimise these degradations.

All these tasks will be run in parallel for both languages, French and Spanish. In order to study, implement and test improvements, two identical hardware prototypes will be built (one for the French application and one for the Spanish).

The aim of the second phase is the implementation of two demonstrations of speech understanding for air traffic control (one in French, one in Spanish) and the integration of voice input with other devices (such as keyboards, tracker-balls and screens). These demonstrations will require a vocabulary of 100 to 200 words, connected words, and multimedia dialogue.

Contact Point: Mr. Pierre Alinat, THOMSON-CSF/SINTRA-ASM, Chemin des Travails, F - 06801 CAGNES SUR MER
Tel: + 33/ 92-023211
Fax: + 33/ 93-731529
Tlx: 204780 F
Participants: THOMSON-CSF/SINTRA-ASM, CRIN, UNIVERSIDAD POLITECNICA DE VALENCIA, ENA TELECOMUNICACIONES SA

ACQUISITION OF LEXICAL KNOWLEDGE FOR NATURAL LANGUAGE PROCESSING SYSTEMS

Techniques and methodologies for using existing machine-readable dictionaries in the construction of components for natural language processing systems are being developed. The main focus is on the extraction of lexical information from multiple machine-readable sources in a multilingual context, with the overall goal of constructing a single multilingual lexical knowledge-base.

Aims. The ACQUILEX Action aims at solving problems in the following areas:

- the design of a general computational model of a dictionary entry

- the degree to which machine-readable dictionaries contain lexical, syntactic and semantic information which can be made explicit and can be reused in natural language processing systems

- the development of methods and techniques for the extraction of syntactic and semantic information from machine-readable dictionaries

- the semi-automatic construction of taxonomies starting from machine-readable dictionaries

- the design and organisation of a single lexical knowledge-base with concepts and relations for the different languages involved.

Approach and Methods. The approach is based on theoretical linguistics, computational lexicography and lexicology, and computational linguistics. The main themes are:

- A formal analysis of the structure and content of existing machine-readable dictionaries, in order to design an explicit and standardised representation language for the computational model of the dictionary entry.

- The design of procedures for the extraction of superordinates from natural language definitions, for their disambiguation, and for the construction of taxonomies throughout the lexicon.

- The design of procedures for the linguistic and computational analysis of natural language definitions, with the aim of extracting all the semantic information implicit in them.

- The study of ways of representing the semantic information which is extracted, e.g. in the form of concepts and relations between them.

- The design and implementation of basic software for the creation, accessing and processing of lexical databases and lexical knowledge bases.

- The study of how to link taxonomies and conceptual or relational information coming from different sources (either monolingual or multilingual).

- The design of a natural language processing test-bed for the information extracted from machine-readable dictionaries.

Progress and Results. The results achieved so far are:

- an analysis of the structure and content of the dictionary entry in machine-readable dictionaries, and a proposed computational model for the project dictionary entry

- a first release of lexical database software

- a survey of the needs of natural language processing systems with respect to lexical information The Action is presently working on:

- converting available machine-readable dictionaries into the initial computational model, representing it in a common format across machine-readable sources

- building taxonomies for the different monolingual dictionaries

- merging taxonomies derived from different dictionaries

- defining a subset of the lexicon (about 200 words) on which to perform tests in order to detail criteria and to construct test-cases

- developing a prototype of the natural language processing test-bed system.

Potential. The research themes tackled within ACQUILEX aim to meet one of the major bottlenecks of natural language processing: the availability of large computational lexicons with particular emphasis on making semantic information explicit and accessible.

41

Latest Publications

Boguraev B., Briscoe T., Copestake A. "Enjoy the paper: lexical semantics via lexicology." In: COLING' 90, Helsinki (1990). Calzolari N., Zampolli A. "Lexical databases and textual corpora: a trend of convergence between computational linguistics and literary and linguistics computing." In: Proc. ACH/ALLC Conference, Toronto, Oxford University Press (in press).

Vossen P. "Polysemy and vagueness of meaning description in the Longman Dictionary of Contemporary English." In: Svartvik, Wekker (eds), Topics in English Linguistics, Mouton de Gruyter (in press).

Information Dissemination Activities. A workshop is planned in Cambridge on 26-28 November, 1990. Participation and presentation of related papers in international conferences such as COLING at Helsinki, BURALEX at Malaga is planned.

Contact Point: Prof. A. Zampolli, Universita di Pisa, Dipartimento di Linguistica, Via Della Fagiella 32, I - 56100 PISA
Tel: +39/50-560481
Fax: +39/50-576751
E-mail: glottolo@icnuccvm
Partners: Consiglio Nazionale delle Ricerche, Universiteit van Amsterdam, University of Cambridge, University College Dublin, Universidad Politecnica de Cataluna E

INTERACTIVE DIALOGUES FOR EXPLANATION AND LEARNING

A unifying framework of dialogue models for explanation and learning is being developed. The three main research themes are: the theoretical study of discourse for conversational control in didactic situations; the experimental study of optimal explanatory strategies and media; and the creation of a computational architecture of models and processes to retrieve domain knowledge and control explanatory conversations.

Aims. The IDEAL Action aims to answer the following questions:

- How can theoretical discourse models of explanatory situations be used for the contextually appropriate control of human/computer interaction?

- What are the optimal choices of media for explaining different types of knowledge?

- How can visual media be used with explanatory discourse?

- How are user requests for information analysed in a conversational context of discourse focus?

- How is the appropriate domain knowledge retrieved in order to satisfy requests?

Approach and Methods. The results of three theoretical and empirical themes feed into a fourth theme, computational modelling:

1. Theory of explanatory discourse and dialogue modelling (linguistic theme) will create a theory of explanatory discourse linking speech acts, topic focus, and planning, based on situation semantics and functional discourse theories. The theory, empirically validated by analysis of a corpus of natural explanations, will contribute to the development of computational models for query analysis, discourse focus maintenance, and the planning of explanations.

2. Experimental studies of dialogue styles and presentation media investigates the effectiveness of different styles (e.g. active/passive expert, etc.) and presentation media on learning. These experiments on acquisition, conceptualisation and structuring of knowledge during explanation will create guidelines for the best strategies to follow according to the educational situation.

3. Knowledge representation, retrieval and management concerns the representation of domain knowledge and researches mechanisms for retrieving appropriate domain knowledge. It is also responsible for student models and the process of knowledge acquisition.

4. Integrated computational models for explanation takes the results of 1.-3. above and creates an integrated family of computational models which handle dialogue control, query analysis, knowledge retrieval, and explanation generation in a context-sensitive manner.

Progress and Results. Several papers are now available. In November 1990 deliverables will be finished covering the following areas:

- theory of explanatory discourse, including empirical studies on natural explanations

- knowledge representation, retrieval and update processes for domain knowledge and student models

Potential. The output from IDEAL will provide the theoretical basis for the next generation of adaptive intelligent tutoring systems. The results will also be applicable to explanation facilities and advisory systems as well as contributing towards the better theoretical and practical understanding of the contextual control of human/computer conversations.

Latest Publications

Sutcliffe, A. G., Cooper, M. A., Ferrari, G. "A preliminary theory of explanatory discourse." In: Proceedings of Alvey/IED workshop on Explanation V. Manchester, UK Filer N (ed) (1990).

Sutcliffe, A. G. "Computational models for visual communication in multimedia discourse." In: Proceedings Vth European Conference on Cognitive Ergonomics, Urbino, Italy. G. van der Veer (ed) (1990).

Johnson, H. and Johnson, P. "Interactive dialogues for explanation and learning (IDEAL): the effects of different

explanatory styles on Llarning by non-experts." In: Proceedings of Alvey/IED workshop on Explanation V. Manchester, UK. Filer N (ed) (1990).

Information Dissemination Activities. Joint workshops will be held with other ESPRIT projects involving human/computer interaction and knowledge-based systems.

Contact Point: Dr. A. Sutcliffe, City University, Dept of Business Computing, Northampton Square, UK - LONDON EC1V 0HB
Tel: +44/71-253-4399 ext 3420
Fax: +44/71-608-1270
E-mail: sf328@uk.ac.city
Partners: Queen Mary College, Universita di Pisa, Instituto di Linguistica Computazionale - CNR, University of the Aegean

DYNAMIC INTERPRETATION OF NATURAL LANGUAGE (DYANA)

Fundamental questions about the integration of logic, natural language and speech are addressed, focusing on the themes of partial information and dynamic interpretation in natural language processing, with particular attention to developing a computational and cognitively motivated model of how spoken language is understood.

Aims. DYANA Action aims to answer the following questions:

- What declarative theory of grammar (extending from phonetics to discourse) would best support incremental interpretation and top-down information flow?

- How can existing unification-based grammar formalisms be developed so as to increase their ability to express high-level generalisations, while retaining a clear semantics and computational interpretation?

- How is the informational content of an utterance integrated into the current discourse context? •
  What formal models can adequately capture the defeasibility and non-monotonic character of human reasoning?

- To what extent is it possible to synthesise the formal methods used for modelling partial information in speech, grammar, semantics and reasoning?

Approach and Methods. The work is divided into three inter-dependent themes:

- Grammar development, speech and prosody, emphasising the development of formal models, the abstract specification and parametric variation of linguistic structure, the incorporation of intonational structure into the representation of utterances, and the investigation of the interplay of intelligibility, predictability and discourse context in speech recognition and production.

- Meaning, discourse and reasoning, addressing the further development of the dynamic and partial models of meaning that have been emerging in the past decade. In addition, non-monotonic logic will be used, taking into account conditional reasoning and infeasibility in lexical concept combination, and to formalise forms of default interpretation that play a role in various aspects of linguistic structures.

- Logic and computation, directed towards the development of formal mathematical and computationally tractable models of natural language, encompassing recent extensions of unification formalisms. In the final phase of this Action, work on classes of algebraic description spaces and a comprehensive unification formalism for linguistic applications will be incorporated and implemented, as well as a proof theory for temporal formalisms.

Progress and Results. The available deliverables cover the following areas:

- Grammar development. speech and prosody: parametric variation in German and Romance; Flexible Montague Grammar; psycholinguistic studies in the incremental interpretation of speech; the labelling of intonation contours.

- Meaning, discourse and reasoning: generalised quantifier logic for naked infinitives; dynamic predicate logic; Dynamic Montague Grammar; the semantics of progressives and perfects, conditionals, defaults and belief revision.

- Logic and computation: a comprehensive unification formalism for linguistic applications; constraint logic programming for natural language analysis; foundations of unification-based formalisms. Other deliverables include a prototype intonational parser, and a (nearly) deterministic parser.

Potential. The research themes that constitute the DYANA Action aim to meet some of the challenges that lie ahead on our way to computer systems that use spoken or written human language. Although the major aim of the Action is to carry out fundamental research in natural language processing, work is also directed towards the development of prototypes and proof-of-concept implementations.

Latest Publications

Engdahl, E., et al. (eds) "Parametric variation, Proceedings of a DYANA Workshop." Working Papers in Cognitive Science, Volume 6.Edinburgh: Centre for Cognitive Science (1990).

Groenendijk, J. and Stokhof, M. "Dynamic predicate logic." Linguistics and Philosophy (1990).

Klein, E. and Moens, M. "The dynamic interpretation of natural language." In: Proceedings of the 6th Annual ESPRIT Conference, Brussels, November 27-December 1, 1989, pp 1100-1107, Kluwer (1989).

Wedekind, J. (ed) A" survey of linguistically motivated extensions to unification-based formalisms." DYANA Deliverable R3.1.A. Edinburgh: Centre for Cognitive Science (1990).

HIGH-RESOLUTION SPEECH RECOGNITION: AUDITORY CONNECTIONIST TECHNOLOGIES FOR SPEECH

The computer modelling of auditory processing and connectionist systems for speech recognition is addressed. Based on research into peripheral auditory processing and cognitive research on speech perception and memory, the primary goal is to develop a recognition system that benefits from the preprocessing embodied in current models of the human auditory system.

Aims. The key research questions explored are:

- How can auditory processing performed in the cochlea be simulated?

- How can the transient information concerning the onsets and offsets of parts of speech be extracted from an early stage of the auditory processing chain?

- How can existing connectionist recognisers be developed to perform vowel recognition using the cochlea simulation as a front-end ?

- How can training techniques for connectionist recognisers be improved?

- How do humans perform on a phoneme recognition task in the absence of lexical and contextual constraints?

Approach and Methods. The goal is to construct a recognition system involving (a) a high-resolution front-end processor based on current models of the human auditory system, and (b) a word-recognition system based on abstract phonological representations and a phonological buffer store.

The three parallel research streams aim to:

- Develop a detailed but efficient functional model of human hearing in five stages: spectral analysis, neural transduction, phase alignment, pitch extraction and timbre stabilisation. Feature extraction mechanisms used in the model will be developed in line with psychological research.

- Compare connectionist recogniser performance using auditory preprocessing with conventional spectrographic preprocessing.

- Develop new recogniser architectures and training algorithms in line with psycholinguistic research.

Work is also directed towards developing user documentation for the cochlea simulation software, establishing base-line performance for phoneme recognition using both traditional and auditory front-ends, feature extraction software, and an efficient parallel implementation of a connectionist recogniser. Phonological memory research, experimentation concerning human vowel recognition and human psycho- acoustical research are continuing parts of the project.

Progress and Results. At the present time, developed software and published research on the Action include:

- An efficient computer simulation of cochlea processing; documentation of the software for users in a) speech recognition and b) hearing research; published papers describing experiments on octave perception.

- Efficient implementation of a connectionist recogniser producing performance comparable to the best HMM recognisers; comparisons of the auditory model front-end with FFT filterbank; improved training and pattern- recognition algorithms.

- Review of human vowel and consonant recognition research; experimental research on the structure of human phonological memory.

Potential. This Action is laying the foundations for the construction of balanced and efficient auditory/connectionist speech recognition systems that are founded on cognitive research in the areas of speech perception and memory.

Latest Publications

Robinson, T. and Fallside, F. "Phoneme recognition from the TIMIT database using Recurrent Error Propagation Networks." Technical Report CUED/F-INFENG/TR.42, Cambridge University Department of Engineering, (1990).

Patterson, R. D. and Hirahara, T. "HMM speech recognition using DFT and auditory spectrograms." Technical Report TR-A-0063, ATR Auditory and Visual Perception Research Laboratories (1989).

Rohwer, R. "The 'Moving Targets' training algorithm." In: Advances in Neural Information Processing Systems 2, DS Touretzky, Ed., Morgan Kaufmann, San Mateo, CA, p 558, (1990).

Rodrigues, J. S. and Almeida, L. B. "Improving the learning speeds in topological maps of patterns." In: Neural Networks: Advances and Applications, E Gelenb (ed) North-Holland Publishers (1990).

Partners: University of Cambridge, INPG (CNRS), Instituto de Engenaria de Sistemas e Computadores, University of Edinburgh, UniversiteStatale di Milano, Instituto di Clinica Neurologica

SPEECH PROCESSING AND RECOGNITION USING INTEGRATED Neurocomputing Techniques (SPRINT)

Various unsolved problems in speech recognition are tackled by exploring the particularities of neural networks (e.g., non-linearity, self-organisation, parallelism) to upgrade the performance of automatic speech-recognition systems. The connectionist paradigms are exploited to investigate some of the problems in relationship with speech variabilities: adaptation to new speakers and/or new environments, noise immunity, classification of speech parameters using a set of phonetic symbols, and recognition of isolated words (lexical access).

Aims. The aim of the SPRINT Action is to examine whether connectionist techniques can be used to improve the current performance of automatic speech recognition systems, with particular respect to speaker independence and noise insensitivity.

Answers are sought to the following questions:

- How can the recogniser be provided with robust features adapted to new speakers or environments?

- How can acoustic parameters be mapped onto phonetic symbols using different neural network paradigms?

- How can the competitive learning approach be applied to high-level speech processing in order to understand the lexicon structures?

- How can isolated words be recognised, considering the problems related to time-varying word patterns and noise immunity?

Approach and Methods. The speatic and lexical. The main areas of investigation are:

- The transition from the signal to the parameter level and transitions within the parameter level: research will provide the recognition system with a set of parameters leading to the best performance. Transformations of classical speech representations are investigated, based on multi-layer perceptrons, topological maps, and the learning vector quantification method.

- The transition from the parameter to the phonetics level: various feed-forward neural network topologies have been assessed, and some found to integrate prior knowledge.

- The transition from the phonetic to the (sub)lexical level: the competitive learning approach is used to determine the structure of the lexicon and the structure between morpheme units and the phonemes.

- The transition from the parameter to the lexical level: the ability of various network paradigms to learn to generalise has been examined in order to deal with intra

and inter-speaker variability and background noise. The problem of recognising time-varying speech patterns has been approached by transforming the speech signal to fit the fixed size network input layer. Architectures and hybrid systems that integrate neural networks with well- established approaches are used.

Progress and Results. The available deliverables report on the following research activities:

- Theoretical studies that have been conducted to establish various neural network capabilities to generate any spectral transformation and their classification capabilities to discriminate between several classes, given a network architecture.

- The evaluation of speaker adaptation procedures based on learning spectral transformation with multi-layer perceptrons. Well-established methods were compared.

- The use of neural networks to carry out the transformations of speech parameters, necessary for recognition which is robust with respect to speech signals which are contaminated by background noise. Preliminary experiments have been carried out.

- The examination of network techniques for spectrum classification and robust recognition of isolated words. The focus is on the evaluation of various structures of multi-layer perceptrons and neural networks with different topologies.

- The use of added noise in training to improve generalisation.

Work is now proceeding on the development of a hybrid system, combining the technique of hidden Markov modelling with multilayer perception approaches.

Potential. The basic know-how acquired and the tools developed will be used in the next step to meet the challenge of integrating these techniques within an automatic speech recogniser. Furthermore, this work will be exploited in other areas such as pattern recognition (image, fonts, characters).

Latest Publications

Choukri, K. et al. "SPRINT: speech processing and recognition using integrated Neurocomputing techniques." International Journal of Neurocomputing, 2, No. 2 (1990).

Choukri, K. et al. "Speech processing and recognition using integrated neurocomputing techniques." In: Proc. 1990 ESPRIT Conf., Kluwer (in press).

Bimbot, F., Chollet, G, Tubach, J. "Phonetic features extraction using time delay neural networks." In: NATO-ASI Workshop on Speech Recognition and Understanding (1990).

Gallinari, P. "A neural net classifier combining unsupervised and supervised learning." In: International Conference on Neural Networks (ICNN), Paris, 9-12 (July 1990).

ARTICULATORY-ACOUSTIC CORRELATIONS IN COARTICULATORY PROCESSES: A CROSS-LANGUAGE INVESTIGATION (ACCCOR)

Modelling the underlying physiological and linguistic constraints on the dynamics of articulation during speech production is undertaken. A cross-language study of coarticulation identifies the major language- independent universal regularities of the phenomenon and how they interact with language-specific factors. Investigations of coarticulatory regularities are integrated with new and improved ways of exploiting these regularities in deriving articulatory representations from the acoustic analysis of speech.

Aims. Recent theoretical and experimental work on speech production strongly indicates the need for a comprehensive cross-language programme of basic research to expand knowledge of the language-specific and language-independent regularities involved. For many applications in speech technology the availability of an articulatory representation of speech utterances would mean substantial progress. For example, in the automatic recognition of continuous speech one of the major barriers to robust speaker-independent systems has been the great variability in the relationship between the acoustic level of representation and the phonological structure of a given utterance.

However, the variability can itself become a productive source of information if the underlying physiological and linguistic constraints of the dynamics of articulation can be modelled, and this is the goal of the ACCOR Action. The main source of systematic variability at the segmental level is undoubtedly coarticulation, the main focus of the work.

Approach and Methods. A cross-language approach is adopted in the ACCOR Action as a means of identifying the major language-independent universal regularities of the phenomenon (aspects such as mass, inertia and elasticity of the speech organs, the mechanical linkages between them and the neuromuscular complexities of the cranial nervous system), and how they interact with language-specific factors such as the phonological rules of the languages concerned.

Work began by examining the activities of the major physiological systems underlying speech production: the respiratory system (producing a flow of air), the laryngeal system (modifying the airflow by the valving mechanism of the vocal folds), and the complex supraglottal structures in the mouth and nose (such as the tongue, lips, jaw and soft palate, which shape the vocal tract into different resonating cavities).

In addition, by examining the details of a given articulatory process for a number of different languages, ACCOR aims to determine how such processes differ according to different phonological systems, and thus to be in a position to investigate interactions between the two sources of variation. A common methodology, standardised investigation tools and measurement procedures at specified locations in the speech signal have been adopted.

Progress and Results. Deliverables and papers cover the following areas:

- Hardware and software development for digital recording of articulatory and acoustic data. A PC-based prototype of a multichannel speech workstation has been designed.

- Research into the instrumental investigation of articulatory activity.

- Review of connected speech processes in English, French, German and Italian.

- A core lexicon for English, French, German, Italian, Spanish and Swedish has been established, consisting of consonant-vowel-consonant nonsense words; real words matching the phonetic structure of the nonsense words as closely as possible; and sentences illustrating the main connected speech processes in different languages. A complete set of recordings is available for 5 speakers of each language.

- A common methodology has been adopted for segmenting and labelling the data. It is based on a non-linear and independent annotation of the articulatory and acoustic events.

- The interpretation of articulatory and acoustic data in terms of a production model is in progress.

Potential. This Action integrates investigations into coarticulatory regularities with research into new and improved ways of exploiting these regularities in deriving articulatory representations through the acoustic analysis of speech. The knowledge gained will show the most promising paths to follow in many speech technology applications, particularly in the development of more robust speech recognition systems.

Latest Publications

Encetrand, O. "Towards an electropalatographic specification of consonant articulation in Swedish." PERILUS, 10;115-156 (1989).

Hardcastke, W. J. and Marchal, A. (eds) "Speech Production and Speech Modelling." Dordrecht, The Netherlands, Kluwer (1990).

Recasens, D. "An electropalatographic and acoustical study of consonant-to-vowel coarticulation." Phonetics (in press). Hoole, P., Geroerer, S., Tillman, H. G.

"Electromagnetic articulography as a tool in the study of coarticulation." Phonetics (in press).

Information Dissemination Activities. A textbook on instrumental investigation of coarticulation will be published. Partners of the Action will report its progress at the main international conferences (ASA, ICPhs, ICA). A symposium on "Speech Processes in the Light of Action Theory and Event Perception" will be organised in Stockholm in August 1991.

Contact Point: Prof. A. Marchal, CNRS, Institut de Phonetique, Av. Robert Schuman 29, F - 13621 AIX EN PROVENCE
Tel: +33/42-204-356
Fax: +33/42-205-905
Partners: CNR-Padova, Ludwig Maximilians Universitaet, Siemens AG, University of Stockholm, Universidad Politecnica de Valencia, Universit t Autonoma de Barcelona, University of Reading, University of Dublin - TCD

DIALOGUE AND DISCOURSE (DANDI)

This working group coordinates and stimulates scientific cooperation between European research centres involved in studying the question of how information is encoded in and extracted from discourse.

Aims. DANDI aims to:

- Facilitate communication and increase the interaction and scientific cooperation between European research centres involved in the study of dialogue and discourse.

- Encourage new axes of communication to form across consortia boundaries, thus stimulating new areas of collaboration and new research initiatives.

- Help and strengthen a wider European community of researchers concerned with problems of cognition and language.

Approach and Methods. The key questions addressed by the Working Group are organised around the following topics:

- questions and answers: what constitutes an appropriate answer to a given question? Can the process of integrating newly conveyed information with discourse-specific or domain knowledge be described as a process of cognitive questioning?

- focus, topic, comment and presupposition: does the topic-comment structure of discourse reflect this process of cognitive questioning? What is the relation between topicality and presupposition?

- intonation: how is the given/new and the topic/comment structure of discourse marked intonationally?

- text coherence: what are the processing implications of explicit markers of text coherence? When a text seems to lack coherence, to what extent can extra material be accommodated in the discourse model to produce a coherent interpretation?

- lexical semantics: how can words be stored in such a way that they can interact with the information emanating from preceding discourse, in generation as well as understanding?

To increase collaboration on these issues, DANDI provides a framework for visits to other research sites, for the organisation of workshops and special interest groups, and for the exchange of research results.

Progress and Results. DANDI supports collaboration between existing research teams. During the first year of activity, a number of special interest groups were created:

- Discourse Relations and their Linguistic Expression

- Questions

- Communication Failure and Repair

- Accommodation and Presupposition.

Potential. In future, the DANDI working group will forge closer links between DANDI and related Basic Research Actions and other ESPRIT projects. Links with other ESPRIT projects are particularly important as we would like to explore ways of communicating results from the basic research issues on which DANDI focuses to more industry-oriented research groups.

Latest Publications

Airenti, G., Bara, B., Colombetti, M. "Knowledge for communication." In: Taylor M, Noel F, Bouwhuis, D. (eds) The Structure of Multimodal Dialogue, Amsterdam, North-Holland (1990).

Dunbar, G., Franks, B., Myers, T. "Papers from the 1989 Edinburgh Round Table on the Mental Lexicon." Edinburgh: Centre for Cognitive Science (1989).

Klein, E., Moens, M. "Dialogue and discourse." In: ESPRIT '89: Proc. 6th Annual Esprit Conference, Brussels, 27 November - 1 December, 1989, pp 1112-1117 (1989).

Lonning, J. T. "Computational semantics of mass terms." COSMOS Report No. 14, Department of Mathematics, University of Oslo (1990).

Information Dissemination Activities. A number of workshops have been organised by these special interest groups.

After the first year a booklet was produced describing the DANDI consortia and the research interests of the individual members. DANDI initiatives are announced in the newsletter of the Basic Research Action 3175, DYANA.

Contact Point: Mr. M. Moens, University of Edinburgh, Centre for Cognitive Science, 2, Buccleuch Place, UK - EDINBURGH EH8 9LW
Tel: +44/31 667-1011 ext 6444
Fax: +44/31 662-4912
E-mail: marc@cogsci.ed.ac.uk
Partners: BIM, Copenhagen School of Economics, Ecole Polytechnique de Paris, Istituto Dalle Molle, Institut fur Deutsche Sprache, Linguistics Institute of Ireland, Max-

Planck Institut fur Psycholinguistik, Nijmegen, UMIST, Manchester, Universitaet Saarlands, Universiteit Antwerpen, University of Cambridge, University of Essex, Universite de Liege, Universita di Milano, Universiteit Nijmegen, University of Oslo, Universiteit Tilburg