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TR-I-0312

Research Activities
of the
Natural Language Understanding Department
and the
Data Processing Department
for **Apr. 1992~Jan. 1993**

ATR Interpreting Telephony Research Laboratories

February 28 , 1993

ATR Interpreting Telephony Research Laboratories

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Abstract

This report summarizes the research activities of the language-related departments in the ATR Interpreting Telephony Research Laboratories: the *Natural Language Understanding Department* and the *Data Processing Department.* Also contained are reprints of the related technical publications during Apr. 1992.~ Jan. 1993.

The research areas of the Data Processing Department are

(1) Integration of Speech and Language Processing
- HMM-LR Speech Recognition
- Speech Recognition Using Stochastic Language Models
- Construction of Sentential Grammar for Speech Recognition
- Utilization of Higher-level Linguistic Knowledge for Spoken Dialogue Processing

(2) Language Processing for Spoken Dialogue Translation
- Analysis of Japanese
- Transfer from Japanese into English
- Generation of English

(3) Development of a Prototype System for Spoken Dialogue Translation
- General Overview
- International Joint Experiments toward Interpreting Telephony *8*
- The system evaluation

(4) Linguistic Database
- Construction of Linguistic Database and its Management

The current research areas of the Natural Language Understanding Department include:

(5)Dialogue Modeling and Context-Based Inferences
- Plan Recognition Model for Dialogue Understanding
- A model for Conversational Sentence Analysis

(6)Example-Based Approaches in Natural Language Processing
- Integration of EBA and RBA
- Acceleration of Retrieving Similar Examples
- Structural Distance in EBMT

(7)Cooperative Processing Approach in Machine Translation
- Transfer-Driven Machine Translation(TDMT)
- Multi-agent Mechanism for Natural-Language Processing

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1. Research Organizations:
ATR Interpreting Telephony Research Laboratories

An Automatic Telephone Interpretation system is a facility which enables a person speaking in one language to communicate readily by telephone with someone speaking another language. At least three constituent technologies are necessary for such a system: *speech recognition*, *machine translation*, and *speech synthesis*. Integrated research into these technologies is also very important. A feasibility study, published by the Japanese Ministry of Posts and Telecommunications, says that realizing such a system will require at least fifteen years.

Basic research on each of the above technologies has already started at the ATR Interpreting Telephony Research Laboratories of which Dr. Akira Kurematsu is the president. These laboratories were founded in April, 1986 with the support of the Japan Key Technology Center, ATR International, NTT, KDD, NHK and other Japanese enterprises.

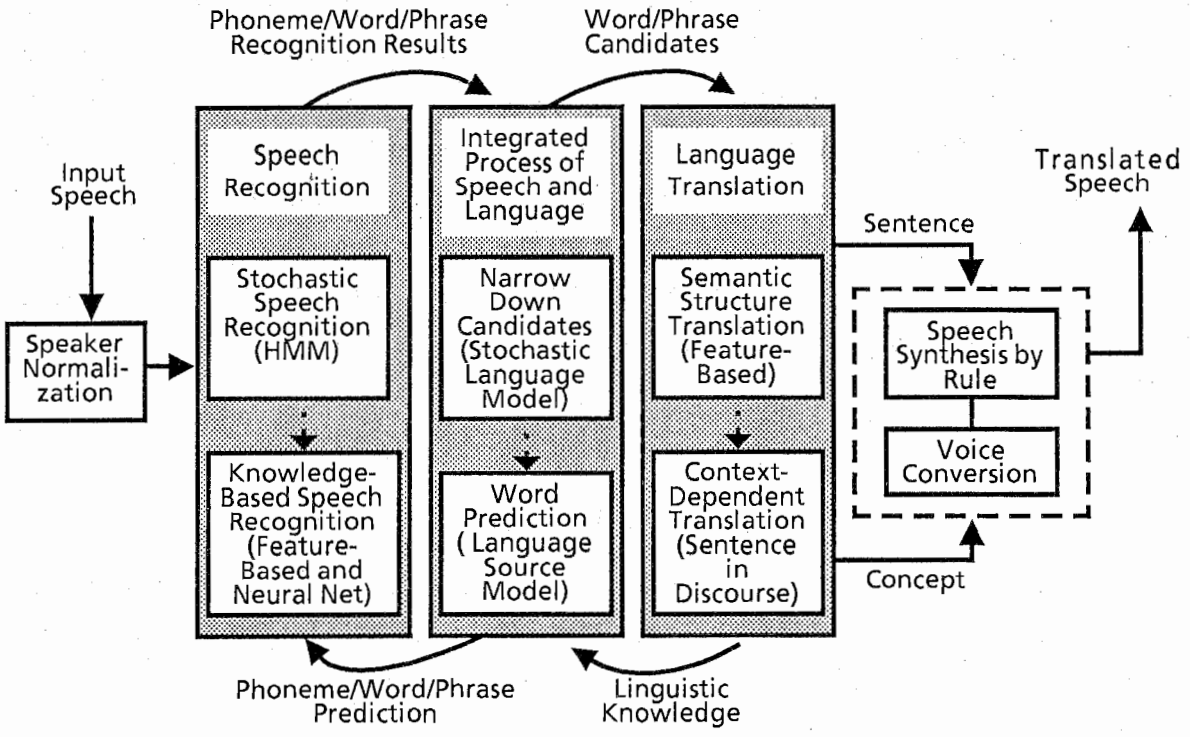

Figure 1. Proposed Automatic Telephone Interpretation System.

The ATR Interpreting Telephony Research Laboratories have three departments: the Speech Processing Department, the Natural Language Understanding Department and the Data Processing Department. These three departments cover the respective research areas to demonstrate the feasibility of an automatic telephone interpretation system shown in **Figure 1.** In this figure,

the speech processing department is concerned with speech recognition, speech synthesis, speaker normalization, and voice conversion. The main research area of the natural language understanding department is language translation, and that of the Data processing department is integrated processing of speech and language.

Technical Publications: [Kurematsu 92-10]

2. Research Activities

Research activities and the related technical publications for 1992 are summarized in Sections 2.1 through 2.4 for the Data Processing Department, and in Sections 2.5 through 2.7 for the Natural Language Understanding Department.

2.1. Integration of Speech and Language Processing

2.1.1 HMM-LR Speech Recognition

One of the major problems in speech recognition is coping with large search spaces. As search space size increases, recognition performance decreases. Syntactic constraints are effective in reducing the search space and hence increase processing speed and recognition accuracy. HMM-LR is an efficient speech recognition algorithm using Hidden Markov Models (HMMs) and predictive LR parsing. Predictive LR parsing is an extension of generalized LR parsing, and makes it possible to predict phonemes in speech according to a context-free grammar. Predicted phonemes are then verified by using corresponding HMMs. The beam-search technique is also used to reduce the search space.

Technical Publications : [Kita 92-04] [Kita 92-07] [Kita 93-01]

2.1.2 Speech Recognition Using Stochastic Language Models

To take into account the stochastic characteristics of a language, we incorporated stochastic language models into the HMM-LR speech recognition system. Three stochastic language models were investigated.

1. Trigram model of Japanese syllables.
   Word bigram/trigram models are extensively used to correct speech recognition errors and improve recognition accuracy. The general idea of a trigram model was applied to Japanese syllables.

2. Stochastic LR parsing.
   The HMM-LR system uses the LR parser to deal with syntactic constraints supplied by a context-free grammar. In a traditional LR parser, each

shift/reduce action is treated equally. However, some actions occur frequently, others rarely. Stochastic LR parsing was introduced to take their frequency of occurrence into account when calculating the recognition likelihood.

3. Bigram model of rewriting rules.
   Using the co-occurrence of rewriting rules, it is possible to prevent CFG rewriting rules from generating incorrect word/phoneme sequences. This mechanism was implemented as a bigram model of CFG rewriting rules.

We applied these stochastic language models to continuously spoken sentence recognition. The recognition rate attained was 83.9%. It was also shown that the rule bigram mode is much superior to stochastic LR parsing in recognition experiments.

Technical Publications : [Kita 92-09] [Kita 92-10-1] [Kita 92-10-2]

2.1.3 Construction of Sentential Grammar for Speech Recognition

We are investigating building syntactic constraints which are effective for speech recognition and can handle spoken Japanese properly.

In contrast to traditional intuitive syntactic classification, we examine the behavior of syntactic categories quantitatively, using dialogue data collected at ATR. Based on the retrieval results together with the speech recognition results, we have tried to find the best trade-off and refined the syntactic rules.

Technical Publications : [Hosaka 92-03] [Hosaka 92-04] [Hosaka 92-07] [Hosaka 92-10-1] [Hosaka 92-10-2]

2.1.4 Utilization of Higher-level Linguistic Knowledge for Spoken Dialogue Processing

One of the key issues in a speech-translation system is how to eliminate ambiguities inherent in speech recognition. In our current speech recognition system, HMM-LR, context-free-grammar based on Japanese phrase structure is used, and then most ungrammatical hypotheses are ruled out during the recognition stage. However, the ability of this grammar is not sufficient because it lacks higher order linguistic constraints such as semantic ones. To compensate for this deficiency, a unification-based Japanese parser, the first stage of the language translation, rules out erroneous candidates and chooses the most plausible one. Other approaches, (a) in which semantic constraints are used during speech recognition and (b) an information-theoretic model of discourse is used for prediction of the next utterance type, are also investigated.

Technical Publications : [Nagata 92-10-1] [Nagata 93-01-3]
[Morimoto 92-10-1]

2.2 Language Processing for Spoken Dialogue Translation

2.2.1 Analysis of Japanese

In the course of extending the analysis grammar for a larger test corpus, we considerably changed the specification of feature structure. The caused a general delay. Nevertheless, a more general grammar was produced, with a broader coverage. The interface between the speech recognition module and analysis was also improved. Now we have two kinds of test corpora: 1) the M-set corpus, including 262 sentences from 12 basic sample dialogues, 2) the E-set corpus, including 638 test sentences various linguistic expressions. The new E-set grammar covers most of these corpora. However, the selection of correct analysis result and the improvement of efficiency are major remaining problems. Thus the basic version of the (M-set grammar) has been used for demonstrations, for reasons of performance. Some valuable experiences in designing and improving grammars (and algorithms) were summarized and published.

Technical Publications: [Nagata 92-07-1] [Nagata 92-07-2]
[Nagata 92-10-1] [Nagata 92-10-2]
[Tashiro 92-10-1] [Tashiro 92-10-2]

2.2.2 Transfer from Japanese into English

Transfer rules for the abovementioned m-set and e-set analysis results have been developed and maintained. We could not avoid introducing many heuristic rules in order to compensate for missing information in the transfer input. The feature structure rewriting system (RWS), the core transfer engine of the prototype system, was improved in efficiency, and we provided some additional functions for describing transfer rules. The system achieved a 24% faster processing speed, using the following techniques:

1. We load only the rule index-file into main memory (while rule bodies remain in disks).

2. We pre-expand feature structures in rule descriptions into internal nodes

A preliminary study contrasting the communicative strategies of Japanese and English was performed, comparing the explicitness of intention. Some typical Japanese expressions (quasi-copula structures) do not indicate the intention of the speaker and often lack significant words. For those utterances, we have to elaborate the original structure, using various kinds of knowledge.

Some knowledge can be provided from the context. Several context-sensitive rules were examined to demonstrate the production of more informative structures. This experiment need a discourse-sensitive version of the system cooperation with the generation component (see next subsection).

Japanese-German transfer rules were developed for the international joint project, CSTAR (see following descriptions).

Technical Publications : [Suzuki 92-07-1] [Suzuki 92-07-2] [Suzuki 92-10] [Tomokiyo 93-01]

2.2.3 Generation of English

In the previous period, a new unification-based generation module was implemented. It has been improved through out this period. Final generation rules (PD's) and morphological synthesis rules have been developed for the current corpora. Much effort has been devoted in order to generate more natural English utterances.

In some generation rules, context-sensitive constraints are considered to dynamically produce of expressions affected by the previous utterance. For realize such processing (also mentioned in the transfer phase), a Discourse Translation Manager (DTM) was implemented. It provides information about discourse clusters (relationships among Demands, Responses and Acknowledgment) in a successive dialogue and manages translation units. Using this DTM, small scale context-sensitive translation was demonstrated.

Furthermore, an attractive method of analyzing sentences using generation rules PDs is being investigated. It takes advantage of the neutral (bidirectional) characteristics of phrasal descriptions with constraints.

Technical Publications : [Kikui 92-06] [Kikui 92-07]

2.3 Development of a Prototype System for Spoken Dialogue Translation

2.3.1 General Overview

The prototype system SL-TRANS II was enhanced and become the a new ASURA system (Advanced Speech Understanding and Rendering system of ATR). The speech recognition module was refined using SSS-LR, an advanced version of the HMM-LR technique, and the translation module was extended in scale and quality. Further, the speaker adaptation technique was also improved. The system seems to have achieved its expected goals. The research history and the results were reported to the public.

Technical Publications : [Morimoto 92-07] [Morimoto 92-10-2]

2.3.2 International Joint Experiments toward Interpreting Telephony

Since its earliest stages, ATR has actively cooperated with foreign research organizations. This effort brought about a close partnership among Carnegie Mellon University(USA), Siemens AG. (Germany) and ATR. These institutes established a Consortium for Speech Translation Advanced Research (CSTAR). According to the proposed schedule, ATR developed Japanese-German translation system, in cooperation with a visiting researcher and an exchange researcher from Siemens AG. The final results were successfully demonstrated as the "International Joint Experiments toward Interpreting Telephony".

2.3.3 The system evaluation

The scale and the quality of the system has been extended through out the research period. A study of evaluation procedures for spoken language translation was executed and actual evaluation of various aspects has been carried out. As for the translation, the coverage of Japanese expressions was measured against an authorized list of standard spoken Japanese expressions. Moreover, the generated English sentences were evaluated by native and bilingual human subjects. The final evaluation results will soon be reported.

Technical Publications : [Uratani 92-07]

2.4 Linguistic Database

2.4.1 Construction of Linguistic Database and its Public Release

The ATR Dialogue Database (ADD) has continuously grown and now contains many dialogue corpora in several domains. Concerning the conference registration task (the current target for the prototype system) and inquiries to a travel agency, 200,000 words of dialogue texts were collected for telephone and keyboard conversations respectively. These corpora (two domains) were released to the public through MT media, supported by ATR International.

Technical Publications : [Morimoto 92-04-1][Morimoto 92-04-1]

2.5 Dialogue Modeling and Context-Based Inferences

It is our belief that telephone interpretation systems should be able to comprehend meaning in context. Major linguistic phenomena peculiar to Japanese spoken dialogues have been investigated from a linguistic viewpoint to construct a discourse-dialogue model that can be implemented on a computer. Among others, research topics concerning elliptical sentences, pragmatics, and intention are being studied, and the results obtained have been integrated step by step as a dialogue interpretation system. Considerable research has been focused

on a plan recognition model for understanding a dialogue. In addition, a computational model for context processing using pragmatic constraints and circumstantial information is being studied. A way to identify differently-expressed noun phrases on the basis of domain knowledge is the first step toward dialogue meaning inference.

Technical Publications : [Iida 92-04] [Iida 93-01-1]

2.5.1 Plan Recognition Model for Dialogue Understanding

A multi-layered plan recognition model for dialogue structure construction and a method to predict the next utterance using the model was proposed.

The model employs three-typed universal pragmatics in addition to a set of domain plans describing actions in the target world. The three pragmatics types are: "Interaction Plan", which describes a sequence of communicative acts for dialogue turn-taking, a "Communication Plan", which determines how to execute or achieve an utterance goal or dialogue goals, and a "Dialogue Plan" for establishing a dialogue construction. These plans should be applied an the following order to recognize the goal of an input utterance: Interaction Plan, Communication Plan, Domain Plan and Dialogue Plan. The system implemented based on this model can efficiently construct appropriate dialogue structures step by step.

A method of utterance prediction is based on model. Using the derived structure and the plans, the method can predict abstract information about the communicative act type and discourse entities of the next utterance in a context-sensitive fashion. An experimental system for reducing the number of candidates of a speech recognition output was implemented, and can improve the number of candidates using contextual information and linguistic and pragmatic knowledge.

Technical Publications: [Iida 92-05][Iida 93-01-2][Yamaoka 92-07]

2.5.2 A Model for Conversational Sentence Analysis

Developing the analysis method for conversation, as well as text, is very important for an application of the natural language processing. As for Japanese conversational sentences,the current constraint-grammar-based approach, such as HPSG, is not adequate due to its inflexibility in the treatment of the absence of complements, postpositions and verbs. We have been developing a new model, called information-based model, for the natural language analysis, which is flexible enough to analyze conversational sentences.

The model leaves most of syntactic and semantic constructions, which are

done by the grammar module in the traditional approaches,to the interpretation module. All possible structures of a given sentence are passed through to the interpretation module, and then the syntactic and semantic interpretations are done respecting the contextual and situational knowledge as well as linguistic knowledge. Such an interpretation module requires an efficient computation mechanism which uses information from multiple resources.

As a step to an efficient interpreter, we propose an inference engine based on the extended chart algorithm. It is a natural extension of bottom-up chart parsers, and works as an abductive prover for the restricted class of logic programs. This class, called head-driven logic programs, is enough to express the interpretation rules for our natural language analysis system. All sorts of interpretation rules, whether syntactic, semantic or discourse-theoretic, are stated as head-driven logic programs. The grammar rules can be also described as a head-driven logic program. Our inference engine treats both of interpretation and grammar rules in the uniform way, thus the two modules are integrated. This also improves the performance of the system.

Technical Publications: [Den 92-05-1][Den 92-05-2][Den 92-09-1] [Den 92-09-2]

2.6 Example-Based Approaches in Natural Language Processing

Study on Example-Based Machine Translation (EBMT) has been pursued in ATR since 1989 in order to overcome problems inherent in conventional Machine Translation. In EBMT, (1) a database which consists of examples (pairs of a source phrase or sentence and its translation) is prepared for translation knowledge; (2) an example whose source part is similar to the input phrase or sentence is retrieved from the example database; (3) by replacements of corresponding words in the target expression of the retrieved example, the translation is obtained.

2.6.1 Integration of Example-Based Approaches and Rule-Based Approaches

We implemented a prototype system called REALIST (Rule + Example = A LingIST). We built an example-based component for prepositions on top of a rule-based start-up system which translates English to Japanese spoken sentences.

Unlike our previous research, the emphasis is on a notorious analysis problem, i.e., structural ambiguity of pp-attachment. In natural language processing, it is of great importance to disambiguate pp-attachment. For instance, in machine translation, if a pp-attachment is not likely, the translation of the preposition, moreover, the whole translation is not likely. We proposed an

Example-Based Disambiguation (EBD) of pp-attachment, which 1) collects examples (a prepositional phrase and the attachment) from a corpus; 2) computes a semantic distance between an input expression and examples; 3) selects the most likely attachment based on the minimum-distance examples. The success rate of our component outperforms conventional statistical methods. We made it clear that our semantic distance calculation using thesaurus overcomes the well-known sparse data problem.

Though the rule-based translation system is not large-scaled and should require future refinement, it deals with basic spoken language and various polite expressions as well. It generates natural Japanese sentences using local contextual information.

2.6.2 Acceleration of retrieving similar examples

Retrieving similar examples from vast example database is computationally demanding. Our experience with iPSC/2 taught us that there was a clear boundary in traditional method using medium-grained parallel processors. We demonstrated the feasibility that fine-grained parallel processors such as IXM2 and CM2 break the boundary. Experimental results showed that retrieving similar examples on IXM2 exhibited the best performance and attained a response speed that would suffice for real-time interpreting telephony.

Papers related to our previous research concerning mainly example-based word selection of various linguistic phenomena are listed below. Papers related to abovementioned research are currently under review will published in near future.

Technical Publications: [Sumita 92-07-1][Sumita 92-07-2][Okada 92-10]

2.6.3 Structural Distance in EBMT

Natural language processing has long been using a pattern matching approach. Rules or linguistic structures are described with the help of variables standing for substructures. A new approach has recently received attention: it tries to retrieve the closest strings or structures by calculating distances between a candidate and constant objects stored in a database.

We explores the idea of theoretically linking a pattern matching operation and a distance. This is realisted for *strings* with *identification* as the pattern matching operation and the *Wagner and Fischer distance* as the string distance. Because identification works both on strings and on trees, a similar relation can be established with a tree-to-tree distance, the *Selkow distance.*

We present a system with two components: a grammar written in a declarative way with variables standing for substructures on one hand, and a

database containing examples of strings with their corresponding linguistic structures on the other hand. The system coherently reconciles the two main approaches in machine translation.

Technical Publications: [Lepage 92-09]

2.7 Cooperative Processing Approach in Machine Translation

In many conventional natural language processing, the analysis module is centered and the analysis results heavily affect following processes such as machine translation modules, foe example transfer and generation. An analysis-centered natural language processing does not always work well because analyzing relationships between words and phrases, or features on linguistic expressions are grasped from a certain monotonic view, in particular one grammar or one semantic category system. Various kinds of linguistic information must be handled simultaneously and satisfy any requirements made by each processing module which works as a sub-problem solver.

2.7.1 Transfer-Driven Machine Translation(TDMT)

We have been studying Transfer-Driven Machine Translation (TDMT) as an empirical approach to MT which utilizes prior translation examples to translate input spoken-dialogue expressions. In spoken-language, there are many expressions which are specific to the domain and deviate from conventional grammar. TDMT efficiently translates spoken-language with translation examples, avoiding complex analysis. In TDMT, transfer knowledge applied to each input sentence, is central to the translation process. When necessary, the transfer module utilizes various other kinds of information by cooperating with other autonomous modules. Target expressions and structures are basically determined using distance calculations of EBMT. To achieve efficient and robust spoken-language translation, TDMT has a good command of various abstract knowledge and translation strategies according to the nature of an input string. We have describe analysis knowledge within example-based framework. A consistent example-based framework makes the cooperation between transfer and analysis effective, and efficient translation is achieved. And we add generation information to transfer knowledge in order to produce a correct translation result. In TDMT, two crucial points are how transfer knowledge is built and how broadly it covers sentences in the domain. Transfer knowledge has been built from a statistical and linguistic investigation of the domain's bilingual spoken-dialogue corpus, and from translation training of the typical expressions in the domain. A Japanese-to-English translation system for a spoken-dialogue about international conference registration is implemented. This approach has

been shown to be promising through pilot experimentation on conversation translations within 1500 Japanese words.

Technical Publications: [Furuse 92-06] [Furuse 92-07-1] [Furuse 92-07-2] [Furuse 92-09]

2.7.2 Multi-agent Mechanism for Natural-Language Processing

Working with multiple-agent systems is a basic research topic. Many approaches were examined. A package for supporting multi-processing on the Sequent parallel computer was developed and a manual written. The BEHOLDER series of algorithms for scheduling multiple tasks under limited resources were designed.

The problems of deciding which of multiple information sources to use and when to stop processing under uncertain conditions were investigated, using value-of-information theory and decision theory. This led to a new mathematics for explicitly representing uncertainty; the B-SURE system tore present situations and uncertain actions in multiple worlds; a system for planning with uncertain actions; and a new, optimal estimator for probabilities in discrete-outcome situations.The results are being applied to the TDMT system.

Finally, a top-down agent-based understanding system designed to solve specific problems in the interpretation demonstration was implemented. The system, known as ABDUCK, uses an extremely simple low-quality agent model to predict the illocutionary force, deep semantics, and surface semantics of the following utterance. This information is used to disambiguate candidates from speech recognition;determine the illocutionary force of utterances, including understanding syntactically-identical utterances such as "hai"; resolve zero-pronoun references;and understand "unagi-da" sentences. The quality of this understanding depends on the quality of the predictions. A high-quality intentional agent model is being prepared for use in this system.

Technical Publications: [Myers 92-06] [Myers 92-07-1] [Myers 92-07-2] [Myers 92-09]

3. Research Staff

The research staff is mainly composed of members from the research institutes and laboratories which support ATR. Also, visiting foreign scientists are included. The following members participated in the Natural Language Understanding Department and Data Processing Department through the end of March, 1992.

Natural Language Understanding Department (Apr.,1986~Jan.,1993)

Name	*Position*	*Period*
Hitoshi Iida	Department Head	Apr., 1986 ~
Osamu Furuse	Senior Researcher	Feb., 1990 ~
Yasuhiro Sobashima	Researcher	Apr., 1992 ~
Takashi Okada	Researcher	Apr., 1991 ~
Kozo Oi	Researcher	Apr., 1991 ~
Masaaki Nagata	Researcher	Mar., 1989 ~
Takayuki Yamaoka	Researcher	May.1989 ~ Mar., 1992
Hiroshi Ohashi	Researcher	Jun., 1991 ~Sept., 1992
Eiichiro Sumita	Visiting Researcher	Apr., 1992 ~
Yasuharu Den	Visiting Researcher	Apr., 1991 ~
Yves Lepage	Visiting Researcher	Nov., 1991 ~
John K. Myers	Visiting Researcher	Sep., 1988 ~
Susann LuperFoy	Visiting Researcher	Mar., 1992~May, 1992

Data Processing Department (Apr.,1986~Jan.,1992)

Name	*Position*	*Period*
Tsuyoshi Morimoto	Department Head	Mar., 1987 ~
Fumihiro Yato	Supervisor	Jun., 1991 ~
Noriyoshi Uratani	Supervisor	Jun., 1991 ~
Masami Suzuki	Senior Researcher	Aug., 1989 ~
Kenji Kita	Senior Researcher	Sep., 1987 ~ Aug., 1992
Kyung-ho Loken-Kim	Senior Researcher	Jan., 1993 ~
Toshiyuki Takezawa	Researcher	Oct., 1989 ~
Toshihisa Tashiro	Researcher	Sep., 1991 ~
Gen-ichiro Kikui	Researcher	Feb., 1990 ~
Junko Hosaka	Visiting Researcher	Oct., 1988 ~
Mutsuko Tomokiyo	Visiting Researcher	Apr., 1990 ~
Mark Seligman	Visiting Researcher	Jan., 1992 ~
Herbert S. Tropf	Visiting Researcher	Feb., 1992 ~ Dec., 1992
Christian Boitet	Invited Researcher	Oct., 1992 ~
Laurel Fais	Visiting Researcher	Apr., 1992 ~

4. Research Facilities in the language-Related Departments

The two language-related departments have common computer systems which consists of VAX 8600/8800 with ULTRIX systems, various types of workstations such as Symbolics 3675 / 3650 / 3620 / XL-1200 / Mac-Ivory, Xerox 1121, Explorer II, SUN 3/4, SPARC 2 , an iPSC parallel computer by INTEL Corp, and a Sequent / symmetry by Sequent Computer Systems, Inc. They are connected through the Ethernet network. Common Lisp and C are the major programming languages used in our departments.

List of Technical Publications of the Natural Language Understanding Department and the Data Processing Department

[April 1992 ~ March 1993]

Ref.ID	Title	Authors	Conference or Journal	page
DEN 92-05-1	対話における情報伝達機構について —効率性と適切性の観点から— [A model of linguistic communication - from the viewpoint of efficiency and appropriateness -]	伝　康晴 [Y. DEN]	日本認知科学会 第15回学習と対話研究分科会 [JCSS, SIGLAL 92, No.1, PP.5-14, 1992]	1
DEN 92-05-2	認知モデルにおける情報の粒度 [Fineness of information in cognitive system]	伝　康晴 [Y. DEN]	日本認知科学会 第9回大会 [JCSS, PP.22-23, 1992]	11
DEN 92-09-1	チャート型構文解析·生成の統一的構造 [A Uniform Architecture for Chart Parsing and Generation]	伝　康晴 [Y. DEN]	日本ソフトウェア科学会 第9回大会 [JSSST, pp.141-144, 1992]	13
DEN 92-09-2	用語解説 情報の効率性 [Efficiency of information]	伝　康晴 [Y. DEN]	人工知能学会誌 [The Journal of JSAI Vol.7 No.5, pp.898-899, 1992]	17
FURUSE 92-06	An Example-Based Method for Transfer-Driven Machine Translation	古瀬　蔵 飯田　仁 [O.FURUSE H.IIDA]	Proc. of TMI-92 pp.139-150, 1992	19
FURUSE 92-07-1	Cooperation between Transfer and Analysis in Example-Based Framework	古瀬　蔵 飯田　仁 [O.FURUSE H.IIDA]	Proc. of COLING 92, Vol. II, pp.645-651, 1992	31
FURUSE 92-07-2	Transfer-Driven Machine Translation	古瀬　蔵 飯田　仁 [O.FURUSE H.IIDA]	Pro. of FGNLP 92 pp. 95-111, 1992	38

Ref.ID	Title	Authors	Conference or Journal	page
FURUSE 92-09	Traduction Automatique Dirigee par le Transfert	古瀬　蔵 Yves Lepage [O.FURUSE]	Japon IA, No.19, pp.15-16, 1992	55
HOSAKA 92-03	ATR対話コーパスを利用した音声認識のための構文規則 [Constructing Syntactic Constraints for Speech Recognition using ATR Dialogue Corpus]	保坂　順子 竹澤　寿幸 江原　輝将 (NHK) [J.HOSAKA T.TAKEZAWA T. EHARA]	文部省科研費総合研究[A]「音声対話」研究成果報告書 [Final Report on "Spoken Dialogues" supported by grant-in-aid of the Ministry of Education, Culture and Science, No.0230510, pp.119-132, 1992]	57
HOSAKA 92-04	Classification of Conjunctive Postpositions in Spoken Japanese toward Speech	保坂　順子 竹沢　寿幸 江原　暉将 (NHK) [J.HOSAKA T.TAKEZAWA T.EHARA]	Literary & Linguistic Computing, Vol.6, No.4, pp.254-258, 1992	71
HOSAKA 92-07	Constructions of Corpus-Based Syntactic Rules for Accurate Speech Recognition	保坂　順子 竹沢　寿幸 [J.HOSAKA T.TAKEZAWA]	Proc. of COLING 92, Vol.II, pp.806-812, 1992	77
HOSAKA 92-10-1	Analyzing Postposition Drop in Spoken Japanese	保坂　順子 竹沢　寿幸 浦谷　則好 [J.HOSAKA T.TAKEZAWA N.URATANI]	Proc. of ICSLP 92, pp.1251-1254, 1992	84
HOSAKA 92-10-2	対話データベースを使った無助詞名詞句の分析 [Analysis of Postposition Drops using Dialogue Database]	保坂　順子 竹澤　寿幸 浦谷　則好 [J.HOSAKA T.TAKEZAWA N. URATANI]	人工知能学会研究会資料「言語･音声理解と対話処理」 [Technical Meeting of JSAI, SIG-SLUD-9203, pp.1-7, 1992]	88

Ref.ID	Title	Authors	Conference or Journal	page
IIDA 92-04	言語処理と音声処理の統合に向けて [An Approach to the Integration of NLP & SP]	飯田　仁 [H.IIDA]	人工知能学会研究会資料「言語･音声理解と対話処理(第1回)」 [Technical Meeting of JSAI, SIG-SLUD-9201, pp. 55, 1992]	95
IIDA 92-05	Natural Language Dialogue Understanding on a Four-typed Plan Recognition Model	飯田　仁 有田　英一 [H.IIDA E.ARITA]	情報処理学会 英文論文誌 [Journal of Information Processing, Vol. 15, No. 1, pp.60-71,.1992]	96
IIDA 93-01-1	Prospects for Advanced Spoken Dialogue Processing	飯田　仁 [H.IIDA]	電子情報通信学会 英文論文誌D [IEICE TRANS., INF. & SYST., Vol. E76-D, No. 1, pp. 2-8, 1993]	108
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FGNLP 92	International Workshop on Fundamental Research for the Future Generation of Natural Language Processing, 30-31 July, 1992, Manchester, U.K.
ICSLP 92	International Conference on Spoken Language Processing, 12-16 October, 1992, Banff, Canada
NLU & AI	Natural Language Understanding and AI, 12-15 July, 1992, Fukuoka, Japan
SPICIS 92	First Singapore International Conference on Intelligent System Spicis, 28 September-1 October, 1992, Singapore
TAG + Workshop 92	Tree Adjoining Grammar, 24-25 June, 1992, Philadelphia, U.S.A.
TMI-92	Fourth International Conference on Theoretical and Methodological Issues in Machine Translation, 25-27 June, 1992, Montréal, Canada
ACL	Association for Computational Linguistics
ASJ	The Acoustical Society of Japan
IEICE	The Institute of Electronics, Information and Communication Engineers
IPSJ	Information Processing Society of Japan
JCSS	Japanese Cognitive Science Society
JSAI	Japanese Society for Artificial Intelligence
JSSST	Japan Society for Software Science and Technology
SIGLAL	Special Interesting Group on Learning and Language of Japanese Cognitive Science Society
SIG-SLUD	Special Interesting Group on Spoken Language Understanding of Japanese Society of AI

WGNLC	Working Group of Natural Language Understanding and Communication
WGSP	Working Group of Speech Processing

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