

TR-I-0022

**Research Activities**  
*of the*  
**Natural Language Understanding Department**  
*and the*  
**Knowledge and Data Base Department**  
**(April, 1986 through December, 1987)**  
ATR Interpreting Telephony Research Laboratories

February 29, 1988

ATR Interpreting Telephony Research Laboratories

## 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 *Knowledge and Data Base Department*. Also contained are reprints of the related technical publications from April, 1986 through December, 1987.

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

- (1) Dialogue Modeling
  - Linguistic Structure of Dialogue
  - Dialogue Pragmatics
- (2) Mechanisms for Dialogue Comprehension
  - Context Processing
  - Inference Mechanisms for Dialogue Understanding
  - Dialogue Meaning Processing
- (3) Inter-Keyboard Dialogue Translation
  - Segmentation and Functional Analysis of Linguistic Data
  - Unification-Based Method for Analyzing Inter-Keyboard Dialogues
  - User Interface
- (4) Speech Processing Interface
  - Interface between Speech Recognition and Machine Translation

The research areas of the Knowledge and Data Base Department are:

- (5) Language Database
  - Constructing Linguistic Data Base
  - Linguistic Data Base Total Management System
- (6) Knowledge Base
  - Knowledge Base and Dictionary
- (7) Total System Configuration
  - Software Configuration

## Table of Contents

1. Research Organizations	1
1.1 ATR Interpreting Telephony Research Laboratories	1
1.2 Natural Language Understanding Department	1
1.3 Knowledge and Data Base Department	2
2. Research Activities	2
2.1 Dialogue Modeling	3
2.1.1 Linguistic Structure of Dialogue	3
2.1.2 Dialogue Pragmatics	3
2.2 Mechanisms for Dialogue Comprehension	3
2.2.1 Context Processing	3
2.2.2 Inference Mechanisms for Dialogue Understanding	4
2.2.3 Dialogue Meaning Processing	4
2.3 Inter-Keyboard Dialogue Translation	4
2.3.1 Segmentation and Functional Analysis of Linguistic Data	4
2.3.2 Unification-Based Method for Analyzing Inter-Keyboard Dialogues	4
2.3.3 User Interface	5
2.4 Speech Processing Interface	5
2.4.1 Interface between Speech Recognition and Machine Translation	5
2.5 Linguistic Data Base	5
2.5.1 Constructing Linguistic Data Base	5
2.5.2 Linguistic Data Base Total Management System	6
2.6 Knowledge Base	6
2.7 Total System Configuration	6
3. Research Staff	6
4. Research Facilities in the Language-Related Departments	7
List of Technical Publications	8
Reprints of Technical Publications	12

## 1. Research Organizations

### 1.1 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*. 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.

The ATR Interpreting Telephony Research Laboratories have three departments: the Speech Processing Department, the Natural Language Understanding Department and the Knowledge and Data Base Department. The speech processing department is concerned with speech recognition, speech synthesis, and speech databases. The other two departments cover the language-related research areas that will be described briefly in the following sections.

### 1.2 Natural Language Understanding Department

The Natural Language Understanding Department is headed by Teruaki Aizawa. Its primary goal is to establish a machine translation technology for spoken dialogues. Systems presently available for translating written texts are not applicable here as spoken dialogues contain many peculiar linguistic phenomena not founded in written texts, such as: frequent omission of the subject or part of the predicate; frequent use of polite or honorific expressions; and frequent ambiguities.

In order to qualitatively improve language processings for machine translation, the Natural Language Understanding Department now has four research groups: *dialogue modeling*, *mechanisms for dialogue comprehension*, *inter-keyboard dialogue translation*, and *speech processing interface*.

The *dialogue modeling* research group, directed by Kei Yoshimoto, is working from a linguistic viewpoint to construct a discourse-dialogue model that can be implemented on a computer. The *mechanisms for dialogue comprehension*

research group is directed by Hitoshi Iida. It is concerned implementing context processing, inference, and meaning comprehension on computers. The *inter-keyboard dialogue translation* research group, primary directed by Kiyoshi Kogure, is now carrying on an intermediate step in a study of translation of dialogue between computer terminals. This type of dialogue is fundamentally similar to spoken dialogue and important for practical applications. And the *speech processing interface* research group, directed by Teruaki Aizawa, is focusing on developing an effective interface for speech recognition, speech synthesis, and machine translation components. This group will also collaborate with the other departments.

### 1.3 Knowledge and Data Base Department

The Knowledge and Data Base Department, headed by Tsuyoshi Morimoto, was established in September, 1987 to promote effective research on language-related technologies, including linguistic data base, knowledge base.

The department has now three research groups: *linguistic data base group*, *knowledge base group*, and *total system configuration group*.

The *linguistic data base* research group, directed by Kentaro Ogura, is constructing a linguistic data base. This data base will be widely used by linguistic and speech processing researchers to study the syntactic, contextual or statistical properties of conversational text.

The *knowledge base* research group, directed by Tsuyoshi Morimoto, is trying to define the knowledge, or common sense, necessary to interpret and translate conversational sentences.

The *total system configuration* research group, also directed by Tsuyoshi Morimoto, is structuring problems and developing the necessary technologies outside the area of componential technologies such as speech processing or language processing. These include, for example, the best interface between speech recognition and language processing, hardware configuration that enable the system to process input sentences in real time.

## 2. Research Activities

Research activities and the related technical publications from April, 1986 through December, 1987 are summarized in Sections 2.1 through 2.4 for the Natural Language Understanding Department, and in Sections 2.5 through 2.7 for the Knowledge and Data Base Department.

## 2.1 Dialogue Modeling

### 2.1.1 Linguistic Structure of Dialogue [Yoshimoto]

Japanese topic and anaphora which are important discourse features, especially in spoken discourse, are being studied. These factors have been neglected in the intrasentential research of language so far. A way to syntactically treat Japanese zero pronouns (i.e. omitted obligatory case NPs) on the basis of a Phrase Structure Grammar has been proposed. To identify them on a topic-based discourse model, a feature system has been formalized.

*Technical Publications:* [Yoshimoto 86-10][Yoshimoto 87-8][Yoshimoto 87-9][The results concerning zero pronouns will be presented at COLING'88]

### 2.1.2 Dialogue Pragmatics [Maeda]

The pragmatic aspects of dialogue, such as honorifics, deictic predicates, speech acts, implicature, and inference are being studied. Analysis and generation of Japanese honorifics and deictic predicates, which are important in dealing with Japanese spoken discourse, have been modeled on the basis of honorific and empathic features. Specifically, situational affects on the selection of Japanese honorific and deictic verbs can be treated by setting pragmatic features such as 'honorific value', 'empathy value', and 'benefactive relation'.

*Technical Publications:* [Maeda 87-9][Maeda 87-10][An approach to Japanese honorifics will be presented at ACL'88]

## 2.2 Mechanisms for Dialogue Comprehension

### 2.2.1 Context Processing [Arita, Iida]

Here, the present work on dialogue translation is restricted to a script where inquiries from a researcher to a clerk are made concerning an international conference. The telephone dialogues and inter-keyboard dialogues between computer terminals used in this task domain were collected by simulation.

Based on this simulated data, distinctive telephone and inter-keyboard dialogues feature have been clarified. Inter-keyboard dialogues were shown to have the same fundamental dialogue features as telephone dialogues except for hesitations, corrections, and some interjections. Discourse structures of Japanese inter-keyboard dialogues were also analyzed. In order to build up discourse structures, three clues can be used: type of utterance, clue word, and topic. Discourse structure is one approach to understanding dialogue context.

*Technical Publications:* [Arita 87-5][Arita 87-9][Arita 87-10]

### 2.2.2 Inference Mechanisms for Dialogue Understanding [Nogaito, Hasegawa, Iida]

A dialogue meaning inference mechanism using domain-restricted knowledge is being studied. Currently, interest is being focused on ways to identify differently expressed nominal phrases on the basis of a knowledge base. A method to identify simple nominal phrases using restriction conditions was applied to check certain anaphoras.

*Technical Publications:* [Nogaito 87-9][Nogaito 87-12]

### 2.2.3 Dialogue Meaning Processing [Iida]

Construction and operation of understood meaning of utterance are being studied as a memory model on which context processing, inference and dialogue comprehension mechanisms are to work.

## 2.3 Inter-Keyboard Dialogue Translation

### 2.3.1 Segmentation and Functional Analysis of Linguistic Data [Kume, Kogure]

Segmentation of inter-keyboard dialogue which, like spoken dialogue, abound with ellipsis and grammatically imperfect constructions is being studied. Functions of Japanese dialogue predicates, including speech acts, are also being analyzed.

### 2.3.2 Unification-Based Method for Analyzing Inter-Keyboard Dialogues [Kogure, Kato, Iida]

The development of an experimental Japanese-English translation system which deals with inter-keyboard dialogue as a first step toward spoken dialogue translation has been started. This proposed translation method can be characterized by two translating processes: one which uses interlingua strategy for utterance intentions and the other which transfers propositional parts of utterances.

A method of analyzing inter-keyboard dialogues was developed using a discourse structure based on topic information and the discourse function of sentences. Both topic information and discourse functions are represented by feature structures as well as other syntactico-semantic information. Intra-sentential and inter-sentential structures can be analyzed using the same unification-based phrase structure framework.

Two new algorithms to unify feature structures have been developed based on Wroblewski's non-destructive algorithm; one unifies feature structures without any over copies and the other deals with cyclic feature structures.

*Technical Publications:* [Kogure 87-7][Kogure 87-9][Iida 87-9][Lerat 87-9][Kato 87-11][Iida 87-11]

### 2.3.3 User Interface [Itsumi, Kogure]

A user interface which can help build and revise the experimental inter-keyboard dialogue translation system is now being developed. The current main interest is developing an effective method for displaying a variety of feature structures in unification-based grammars.

*Technical Publications:* [Kogure 87-11]

## 2.4 Speech Processing Interface

### 2.4.1 Interface between Speech Recognition and Machine Translation [Kakigahara, Aizawa]

Since the basic unit of speech recognition is supposed to be a continuously uttered phrase, any input from the speech recognition module to the machine translation module must be a 'phrase lattice', i.e., a set of phrase candidates hypothesized by the speech recognition module. Attention is being focused on function words candidates for these phrase lattices with the assumption being that content words have been already selected.

A method of selecting correct function words was proposed. It consisted of two steps: 1) generate a meaningful sentence by inferring suitable function words for a given set of content words using valency patterns, and 2) compare these inferred function words with the candidates in the phrase lattice to select those most appropriate.

*Technical Publications:* [Kakigahara 87-9][Kakigahara 87-11][Aizawa 87-11][The results will be presented at COLING'88]

## 2.5 Linguistic Data Base

### 2.5.1 Constructing Linguistic Data Base [Ogura, Shinozaki]

We decided to construct a Japanese linguistic data base for the following purposes;

- (1) To analyze various phenomena of spoken dialogue
- (2) To extract statistical properties of spoken sentences

We are compiling spoken texts from simulated telephone conversations and inter-keyboard conversations. A simulated conversation is carried out by a Japanese native speaker, a English native speaker, and an interpreter. The interpreter translates from English to Japanese or vice-versa. The Japanese spoken texts are analyzed for linguistic features such as morphology, kakari-



uke(Japanese modification) relation, and case relation. Finally, the sentences are stored in the data base with information indicating the correspondence between the Japanese and English sentences.

We are planning to construct such a linguistic data base containing more than one million words within the next several years.

### 2.5.2 Linguistic Data Base Total Management System [Ogura, Hashimoto]

As described in 2.5.1, the linguistic data base will be extremely large and its data structure will be very complicated. To manage this data base efficiently and to offer user-friendly interface, a distributed management system is now being developed. Whole data are stored in an extended relational database on a central processor ( Vax ). On user demand, needed parts of data are read from the central data base and transmitted to an onsite work station. At the work station, the data structure is converted to an object-oriented structure so that a user can retrieve the data easily and logically.

### 2.6 Knowledge Base [Morimoto,Kudo,Inoue]

Studies are being carried out on finding the necessary kinds of knowledge and how to formalize them. Currently, we believe that not only hierarchical knowledge about objects(nouns), but also causal or more associative relationships between propositions(verbs) need to be stored in the knowledge base. How to relate knowledge to a lexicon and a transfer dictionary also needs to be studied.

### 2.7 Total System Configuration [Morimoto,Kita]

As described in 2.4.1, interface between speech recognition and language processing is one of the most difficult problems in building an automatic telephone interpreting system. This problem could be broken down into two sub-problems; one is identifying content words and the other is identifying functional words. We are trying to solve the former problem by applying the syntactic, semantic, or statistical properties of conversational sentences. We also expect that applying a knowledge base and dialogue structure will be an effective method to solve this problem.

## 3. Research Staff

The research staff is mainly composed of members from the research institutes and laboratories which support ATR. Also, two visiting foreign scientists are included. The following 21 members have participated in language-related research for the period of April, 1986 to December, 1987.

### Natural Language Understanding Department

<i>Name</i>	<i>Position</i>	<i>Home company</i>	<i>Period</i>
Teruaki Aizawa	Department Head	NHK	April, 1986 ~
Hitoshi Iida	Senior Researcher	NTT	April, 1986 ~
Masako Kume	Researcher	Proper	Jan., 1987 ~
Kei Yoshimoto	Researcher	NTT	Sep., 1986 ~
Kiyoshi Kogure	Researcher	NTT	Sep., 1986 ~
Hidekazu Arita	Researcher	Mitsubishi	Sep., 1986 ~
Koji Kakigahara	Researcher	Matsushita	Oct., 1986 ~
Izuru Nogaito	Researcher	KDD	April, 1986 ~
Hiroyuki Maeda	Researcher	Sharp	Sep., 1986 ~
Toshiro Hasegawa	Researcher	CSK	Nov., 1987 ~
Ken-ichi Itsumi	Researcher	CSK	Sep., 1986 ~
Susumu Kato	Engineer	Nihon Symbolics	April, 1987 ~
Dr. Nadine Lerat	Intern student	ENST, France	April~Nov.,1987
Dr. Rémi Zajac	Invited Researcher	GETA, France	Aug.~Sep.,1987

### Knowledge and Data Base Department

<i>Name</i>	<i>Position</i>	<i>Home company</i>	<i>Period</i>
Tsuyoshi Morimoto	Department Head	NTT	March,1987 ~
Kentaro Ogura	Researcher	NTT	Sep., 1986 ~
Kenzi Kita	Researcher	Oki	Sep., 1987 ~
Naomi Inoue	Researcher	KDD	Aug.,1987 ~
Ikuo Kudo	Researcher	CSK	April,1987 ~
Kazuo Hashimoto	Researcher	Osaka Gas	Sep., 1987 ~
Naoko Shinozaki	Engineer	TIS	Sep., 1986 ~

#### 4. Research Facilities in the language-Related Departments

The two language-related departments have a common computer system which consists of a Vax 8600 with a Ultrix system and various types of Lisp machines such as Symbolics 3675 / 3650 / 3620, Xerox 1121, Explorer II, and Elis. They are connected through the Ethernet network. Every researcher has one of these Lisp machines as his/her workstation. Common Lisp is the major programming language used in our departments.

List of Technical Publications  
of the  
Natural Language Understanding Department  
and the  
Knowledge and Data Base Department  
(April, 1986 through December, 1987)

General Form

[Reference ID] Authors (Affiliation other than ATR):  
(Page) 「Japanese Title」 (Only for a paper written in Japanese.)  
{Page}† “English Title”,  
Conference or Journal (Date).

† English summary for a paper written in Japanese without any English abstract.

- [Iida 86-8] Hitoshi Iida and  
(12) Hirosato Nomura(NTT Basic Research Laboratories):  
“English-Japanese Interactive Translation System: LUTE-AID”,  
International Conference on the state of the Art in Machine  
Translation (1986-8).
- [Yoshimoto 86-10] Kei Yoshimoto:  
{162} 「日本語のゼロ代名詞」  
“Zero Pronouns in Japanese”,  
93rd Meeting of the Linguistic Society of Japan (1986-10).
- [Iida 86-10] Hitoshi Iida, Izuru Nogaito and Teruaki Aizawa:  
(27) 「通訳を介した電話会話の特徴分析」  
{162} “Analysis of Telephone Conversations through an Interpreter”,  
WGNLC Meeting of IEICE, NLC86-(1986-10).
- [Kurematsu 86-11] Akira Kurematsu:  
(35) 「自動翻訳電話のための自然言語処理」  
“Natural Language Processing for Automatic Telephone  
Interpretation”,  
昭和61年電気関係学会関西支部連合大会 S6-2 (1986-11).
- [Iida 86-12] Hitoshi Iida:  
(36) 「将来の通信システムに要求される機械翻訳技術」  
{162} “Requering Machine Translation Techniques for Future  
Communication Systems”,  
昭和61年度情報処理学会関西支部大会(1986-12).
- [Iida 87-3] Hitoshi Iida and Jun-ichi Tsujii (Kyoto University):  
(41) 「『言語処理の理論に関するワークショップ・TINLAP3』の報告」  
“Reports on the Workshop of Theoretical Issues in Natural Language  
Processing -3”,  
WGNLC Meeting of IEICE, NLC86-25 (1986-3).

[Ogura 87-3] Kentaro Ogura:

- (51) 「言語対比データの構築について」  
 “Construction of Data for Language Comparison”,  
 IEICE Spring Meeting 1642 (1987-3).

[Nogaito 87-3] Izuru Nogaito:

- (52) 「電話会話における指示・省略の特徴分析」  
 “Analysis of Reference & Ellipsis in Telephone Conversations”,  
 IEICE Spring Meeting (1987-3).

[Arita 87-5] Hidekazu Arita, Kiyoshi Kogure, Izuru Nogaito, Hiroyuki Maeda  
 and Hitoshi Iida:

- (53) 「メディアに依存する会話の様式～電話会話とキーボード会話の比較～」  
 “Media-Dependent Conversation Manners ~ Comparison of  
 Telephone and Keyboard Conversations ~”,  
 WGNL Meeting of IPSJ 61-5 (1987-5).

[Aizawa 87-5] Teruaki Aizawa and Syun Tutiya (Chiba University):

- (61) 「シンポジウム『通信と談話における意図とプラン』の概要報告」  
 “Outline of Symposium on Intentions and Plans in Communication  
 and Discourse”,  
 WGNL Meeting of IPSJ 61-6 (1987-5).

[Iida 87-6] Hitoshi Iida, Jun-ichi Tsujii (Kyoto University) and  
 Shun Ishizaki (Electrotechnical Laboratory):

- (69) 「TINLAP3に出席して」  
 “Reports on TINLAP 3”,  
 Journal of Japanese Society for Artificial Intelligence (1987-6).

[Kogure 87-7] Kiyoshi Kogure, Hidekazu Arita, Izuru Nogaito and Hitoshi Iida:

- (73) 「端末間対話における言語理解方式」  
 “An Understanding Method of Inter-Keyboard Dialogs”,  
 WGNL Meeting of IPSJ 62-11 (1987-7).

[Yoshimoto 87-8] Kei Yoshimoto:

- (81) “Identification of Zero Pronouns in Japanese”,  
 The XIVth International Congress of Linguists, East Berlin (1987-8).

[Kogure 87-9] Kiyoshi Kogure, Hiroyuki Maeda and Hitoshi Iida:

- (86) 「端末間対話における発話の解析」  
 {162} “An Analysis Method of Inter-Keyboard Dialogs”,  
 IPSJ Fall Meeting 3T-2 (1987-9).

[Nogaito 87-9] Izuru Nogaito:

- (88) 「対話理解における発話の同等性」  
 {163} “A Semantic Identity of Noun Phrases in Inter-Keyboard Dialogs”,  
 IPSJ Fall Meeting 5T-1 (1987-9).

- [Kakigahara 87-9] Koji Kakigahara and Teruaki Aizawa:  
 (90) 「対話文における誤り訂正処理の一考察」  
 {163} “A Study on Error-Correcting Method in Spoken Dialogue”,  
 IPSJ Fall Meeting 6S-1 (1987-9).
- [Arita 87-9] Hidekazu Arita and Hitoshi Iida:  
 (92) 「日本語対話の構造とその解析法」  
 {163} “Discourse Structure of Japanese Inter-Keyboard Dialogs”,  
 IPSJ Fall Meeting 6T-1 (1987-9).
- [Iida 87-9] Hitoshi Iida, Kiyoshi Kogure and Kei Yoshimoto:  
 (94) 「端末間対話翻訳の発話変換手法」  
 {163} “An Interpretation Method for Inter-Keyboard Dialogs”,  
 IPSJ Fall Meeting 3S-7 (1987-9).
- [Yoshimoto 87-9] Kei Yoshimoto:  
 (96) 「日本語の談話における主題の扱い」  
 {164} “Topic in Japanese Discourse”,  
 IPSJ Fall Meeting 6T-3 (1987-9).
- [Maeda 87-9] Hiroyuki Maeda, Kiyoshi Kogure and Hitoshi Iida:  
 (98) 「対話文生成における待遇性の扱い」  
 {164} “The Treatment of Situation Affects in Dialogue Generation”,  
 IPSJ Fall Meeting 4T-3 (1987-9).
- [Lerat 87-9] Nadine Lerat and Teruaki Aizawa:  
 (100) “Redefining Unification in Semantic Networks towards Natural  
 Language Understanding”,  
 IPSJ Fall Meeting 1P-9 (1987-9).
- [Morimoto 87-9] Tsuyoshi Morimoto:  
 (102) 「文書意味検索システムとその日本語解析機能」  
 “Documents Semantics Retrieval System and its Japanese  
 Processing”,  
 IPSJ Fall Meeting 2T-7 (1987-9).
- [Kudo 87-9] Ikuo Kudo, Hideya Koshino (CSK Research Institute),  
 (104) Moonkyung Chung (CSK Research Institute):  
 「機械翻訳による英語CAIのモニターについて」  
 “Monitor of the ‘EIGO CAI’ System Based on Machine-Translation  
 Techniques”,  
 IPSJ Fall Meeting 4Ee-5 (1987-9).
- [Maeda 87-10] Hiroyuki Maeda, Kiyoshi Kogure, Masako Kume and  
 (106) Hitoshi Iida:  
 「待遇性を考慮した対話文生成」  
 “Generating Dialogue-Discourse Considering Situational Affects”,  
 WGNLC Meeting of IEIEC, NLC87-9 (1987-10).

[Arita 87-10] Hidekazu Arita and Hitoshi Iida:

(114) 「日本語におけるタスクオリエンテッドな対話の構造～電話対話と  
端間対話の比較～」

Discourse Structure of Task-Oriented Dialogue in Japanese  
～Comparison of Telephone and Keyboard Conversations～,  
WGNLC Meeting of IEIEC, NLC87-10 (1987-10).

[Kogure 87-11] Kiyoshi Kogure and

(121) Hirosato Nomura (NTT Basic Research Laboratories):

“Computer Environment for Meaning Structure Representation and  
Manipulation in Machine Translation System LUTE”,  
International Conference on Information and Knowledge (1987-11).

[Kakigahara 87-11] Koji Kakigahara and Teruaki Aizawa:

(133) 「対話文における誤入力訂正処理」

“Error-Correcting Method in Spoken Dialogue”,  
WGNL Meeting of IPSJ 64-8 (1987-11).

[Kato 87-11] Susumu Kato and Kiyoshi Kogure:

(141) 「素性構造の単一化の効率～Wroblewskiのアルゴリズムの拡張～」

“Performance Evaluation of Feature Structure Unification  
Algorithms～Extention of Wroblewski’s Algorithm～”,  
WGNL Meeting of IPSJ 64-9 (1987-11).

[Iida 87-11] Hitoshi Iida, Kiyoshi Kogure and Hiroyuki Maeda:

(149) 「端末間の対話通訳システム」

“An Interpretation System for Inter-Keyboard Dialogues”,  
WGNL Meeting of IPSJ 64-10 (1987-11).

[Aizawa 87-11] Teruaki Aizawa and Koji Kakigahara:

(157) 「電話会話翻訳における言語処理と音声処理のインターフェイス」

“An Interface between Natural Language Processing and Speech  
Processing in Telephone Interpretation System”,  
昭和62年度電気関係学会関西支部連合大会 S7-1 (1987-11).

[Nogaito 1987-12] Izuru Nogaito and Hitoshi Iida:

(158) 「照応・指示関係の同一性の分類・解析」

“Analysis Method of Nominal Anaphora in Dialogues”,  
WGFAI Meeting of JSAI, SIG-FAI-8701-1 (1987-12).