SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP*

REPORT

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Alan W. Bierman, James N. Brown, Robert F. Helms, David Hislop, Cliff Weinstein and Workshop Co-Chairs

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P. O. Box 12194
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University research in natural language processing has reached a level of maturity that justifies an examination of the potential applications of this technology in the requirements and prototypes that support realization of Army Force XXI capabilities. And, there is a current need to identify and focus future basic research to ensure that the full potential of this technology is realized in both military and civilian applications.

The state-of-the-art in natural language processing and, in particular, spoken human-machine dialogue was presented at the workshop by nationally recognized researchers in the field. The state-of-the-art in training systems that illustrate both virtual reality and spoken human-machine dialogue in training systems was demonstrated. Six workshop Working Groups met separately to consider possible applications of spoken human-machine dialogue in Army Force XXI requirements and prototypes. They also identified future basic research requirements in three areas: training; assistance; and operations.

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SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

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INTRODUCTION

The Spoken Human-Machine Dialogue Workshop sponsored by the Army Research Office (ARO), with participation by TRADOC, was held at the Sheraton Imperial Hotel on May 30 through June 1, 1995. This workshop was timely because university research in natural-language processing has reached a level of maturity appropriate for examining the integration of natural-language systems into requirements and prototypes that support the realization of Army Force XXI capabilities. There also is a current need to identify and focus future basic research to ensure that the full potential of natural-language processing is realized for both military and civilian applications.

Attendance at the workshop was by invitation only. Attachments A, B and C are respectively: the letter of invitation; administrative instructions to the attendees; and lit of attendees. The workshop agenda is presented in Attachment D.

The workshop started with presentations by three leading researchers in natural-language processing in the US. Cliff Weinstein of the Massachusetts Institute of Technology presented his view of spoken human-machine dialogue 25 years in the future based on progress achieved over the past 25 years. Mitch Marcus from the University of Pennsylvania presented current research and development efforts in natural-language processing and its implications for applications now and in the future. Alan Biermann, Duke University, discussed natural-language processing concepts within the framework of spoken human-machine dialogue systems.

Following the three introductory presentations, Jim Brown, Curry Guinn and Hal Waters--all of Research Triangle Institute--discussed and demonstrated training and intelligent assistant systems incorporating virtual reality and spoken human-machine dialogue technologies. Demonstrations concluded with a discussion of integrating both spoken dialogue and virtual reality in such systems.

The after-dinner speaker, Thomas Edwards, made an interesting and impressive presentation that graphically depicted the application of advanced communications technology under battle conditions.

Each participant was assigned to one of six Working Groups during breakout sessions to examine and develop issues and applications of spoken human-machine dialogue. Each Working Group was chaired by a representative for the TRADOC BattleLabs and co-chaired by a representative of the Army's scientific community. Where possible participants were given their preferences (1-7) for assignment to the Working Group.

Each working group met for a total of 6 hours to consider integration of natural-language systems into requirements and prototypes that support the realization of Army Force XXI capabilities and to identify future basic research in three applications areas: training; assistance; and operational.

The working groups and their co-chairs were:

- Battle Command

  Co-Chairs: CPT Kelly Lauritzen, Cliff Weinstein

1.

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[1] Original plans included a Dismounted Warfighting working group. This was omitted at the workshop because appropriate US Army representatives were not able to attend.

- Mounted Warfighting Battlespace
  Co-Chairs: Chuck Campbell, Curry Guinn
- Combat Service Support
  Co-Chairs: Howard Burnette, A. Joshi
- Depth and Simultaneous Attack
  Co-Chairs: Donald Starck, Don Perlis
- Earl Entry Lethality and Survivability
  Co-Chairs: Dave Carter, Alan Biermann
- Louisiana Maneuvers Task Force
  Co-Chairs: Mitch Marcus, Deanna Jenkins

On the third day of the workshop, the co-chairs of the working groups presented their findings. These findings are elaborated in the body of this report. Finally, MAJ Brad Shaffer summarized the findings of the workshop and closing remarks were made by J. Chandra, ARO.

SPOKEN LANGUAGE DIALOGUE

Alan W. Biermann
Department of Computer Science
Duke University

The purpose of dialogue theory is to enable fast convergence to a goal in a cooperative effort between interacting agents. The methods are toimplement the discovery of critical factors related to the achievement of success, the immediate focus of the conversational partners efforts on those factors, and the proper assigning of duties according to their respective capabilites. The model for the target behaviors is that observed as human collaborators attempt to solve a problem in a voice interactive environment. They usually can quickly perceive the essential bottlenecks to the solution of the problem and they concentrate efforts on those. Their conversation will tend to jump quickly from topic to topic as the needs of the task point to new issues to be adddressed. All interactions account for the abilities of each participant with appropriate voice interactions that omit redundancy and explain only necessary issues.

Such behaviors are in contrast to typical interactions with computers which tend to involve only linear flow of control, a total inability to jump to key issues as the task requires, and little adaptation to the user.

We present a theory of dialogue that is based upon Prolog-like theorem proving and that is aimed at enabling a machine to efficiently interact with a human in a problem solving situation. The mechanisms attempt to prove that the conversational goal has been acheived and then they isolate key parts of the proof that are not present but which could possibly be satisfied through interaction with the human collaborator. Then the system interacts with the user to try to achieve those needed subgoals to complete the proof. If the user knows a method to solve the problem, he or she can take control of the interaction and lead the machine to a solution. The system can easily account for user knowledge by representing it as a part of the Prolog database and letting the natural theorem proving process discover the appropriate interactions. Thus the system, assuming a correctly updated user model, will not waste time requesting user actions that are not feasible or by over explaining issues that the user already understands.

The current state of the art in speech recognition and dialogue theory seems to indicate that these technologies are ready for application to U. S. Army applications. Some example applications would be information retrieval, equipment repair, battle management, and automatic tutoring.

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SPOKEN LANGUAGE DIALOGUE

Mitch Marcus
Computer Science Department
University of Pennsylvania

This report summarizes an overview of the state of the art in automatic speech recognition and natural language processing by computer. It focuses on two topics: the capabilities of current speech recognition systems and a recent major advance in natural language processing which is already responsible for major improvement in components of such systems.

A Brief Consumer's Guide to Speech Recognition

The emergence of effective speech recognition within the last five years has depended on finding methods to solve several simultaneous problems.

First, the segmentation of the speech stream into individual words and letters is extremely difficult. When we listen to speech, we often have the very strong illusion that speech consists of speech sounds and words strung together like beads on a chain, each word touching but distinct from the preceding and following word. The acoustic reality is very different. Examining a speech spectrogram, a visual display of speech, shows that there is no noticeable boundary between either speech sounds or words at all. There are occasional pauses at the ends of groups of words while the speaker breathes, and there are very brief silences produced during the production of so-called "stop" consonants, **p,t,k, b, d, g,** when the tongue or lips briefly block the production of sound, but words otherwise flow seamlessly into each other.

Second, speech information is frequently not local. For example, while our perception, reflected by spelling, is that the words **dose** and **doze** differ in the final consonant, **s** versus **z,** an examination of a speech spectrogram shows that these consonants are acoustically identical. The difference in the identity of the two consonants is actually encoded in the length of the preceding vowel; the **o** in **doze** is much longer than the **o** in **dose**.

Third, there is tremendous variation in speech production both across talkers and within the production of a single talker. There is obvious variation between speakers due to differences in gender, dialect, and the like, but even the same word said by the same speaker can vary tremendously acoustically depending on volume, the speed of the speech, and voice quality. Whispered speech, for example, is fundamentally different acoustically from very softly spoken normal speech; the latter is generated by a very soft but steady periodic tone from the vocal cords, while whispered speech is generated by the aperiodic noise of air turbulence at the back of the throat.

From an engineering point of view, the difficult of a speech recognition task can be characterized along a variety of dimensions:

(1) **Isolated word speech**, where the speaker explicitly stops speaking briefly between each word, is easier to recognize than **continuous speech.**

(2) **Speaker dependent** systems, systems which are explicitly trained for each new talker, perform better than systems that are **speaker independent,** which work immediately for any talker with no previous training for that talker's voice. A good middle ground is provided by **speaker adaptive** systems, which adapt themselves to a given speaker during use, rapidly improving in performance from some original baseline.

(3) Systems with **small vocabularies,** of between 10 and 50 words, have much better performance than systems with **large vocabularies,** of 1000 to 1000,000 words.

(4) Of somewhat more importance than the vocabulary size for a particular task, however, is a measure called **task perplexity**. Because of the difficulty of the recognition task, most current systems constrain the task by combining a fixed vocabulary with some form of **probabilistic language model** which captures the expected probabilities of particular word subsequences. Such a language model can be used to calculate the degree of ambiguity at each point of the parsing process; perplexity is one measure of this ambiguity.

(5) Finally, the **recording conditions** make a large difference in how well speech recognition systems work. The use of noise-cancelling microphones is crucial for good recognition in even moderately noisy environments; high noise levels greatly degrade the accuracy of even the best systems.

Currently, very good performance can be achieved by constraining the recognition task along one or several of the above dimensions. For example, AT\&T Bell Laboratories has achieved recognition rates of 99.2\% string accuracy for a continuous speech, speaker independent, phone quality speech recognition system which works with a very small vocabulary - the ten digits, if the string length is known. Several speaker dependent systems with word error rates of 1-2\% have been developed for moderate vocabulary sizes (1000-5000 words) for moderate perplexity (30-60). In one application that has been the focus of several years of international competition, namely the task of making reservations for airline travel given the information in the Official Airline Guide, systems now correctly understand about 90\% of utterances input by naive users during evaluations where the goal was to accomplish some particular task.

In summary, by tightly controlling task complexity and vocabulary size, very good results can be achieved in hands-busy, eyes-busy environments using current speech recognition technologies.

New Developments in Natural Language Processing

The field of natural language processing (NLP) has undergone a revolution within the past several years. New probabilistic and information-theoretic techniques, combined with the traditional methods of symbolic computing, have dramatically improved the performance of a variety of NLP system components, with continuing improvement expected. In many areas, The performance of techniques which required very costly hand-encoded knowledge representations have now been surpassed by statistical learning methods which automatically extract information from large bodies of annotated and unannotated online text. Much of this work has been done with ARO and other DOD funding, or by researchers originally trained under ARO funding. Important breakthroughs have been achieved in many key areas; we will focus here on three key examples to give a sense of the kind of techniques that have recently been developed. These are:

(1) The problem of part of speech determination -- deciding, for example, whether a particular word in a given linguistic context functions as a singular noun or a past tense verb. A variety of techniques now tag previously unseen material at about 96-97\% word accuracy.

(2) The problem of determining the syntactic structure of naturally occurring texts and utterances. Recently developed probabilistic parsing methods, operating completely without hand-built grammars, provide the correct parse as the first parse output between 60-80\% of the time, by sentence, on newspaper text; they have performed with up to 91\% accuracy on spoken language tasks.

(3) The problem of determining the lexical semantics of verbs. For example, a range of promising techniques for performing automatic word sense disambiguation have now emerged, i.e. whether a given instance of *plant* means a growing thing with leaves or a factory. Most surprisingly, the best technique to date uses an *unsupervised* training method.

We will briefly consider each in turn.

Part of Speech Tagging

To determine the particular grammatical use of each word token in an input stream, a POS tagger must disambiguate words which have the potential to be many different parts of speech. Overcoming this combinatoric bottleneck is a central problem in building any NLP system; given a realistically large lexicon of English, many common words are used in multiple parts of speech. Determining grammatical function is a crucial step toward a wide range of tasks ranging from information extraction to providing a chunking of text into intonation phrases in a text-to-speech synthesizer. The problem of lexical disambiguation was widely believed to be completely intractable ten years ago, and yet now a wide range of very different learning techniques can solve this problem with between 95\% and 97.5\% word accuracy, for sets of between 40 and 80 grammatical functions. All of these techniques depend, however, on availability of hand-tagged materials for training. The best such results have been obtained, somewhat surprisingly, using a new learning method which results in a simple list of symbolic if-then rules; this method was developed by Eric Brill at UPenn, in part under ARO funding. Very recently, Brill, now at Johns Hopkins, has extended this symbolic learning method to produce a 95% correct part-of-speech tagger for English, seeded only with the information in a standard machine readable dictionary.

Stochastic Parsing

Both the purely symbolic parsing techniques and the straightforward combination of symbolic parsing techniques with statistical methods that was explored in the 1980's failed to produce effective parsers; the best parsers from this period achieve about 35\% correct parses on fully reserved test wire-service material.

Within recent years, a range of new grammatical formalisms have been proposed which may well have the potential to solve a major part of this problem. These formalisms, called *lexicalized* grammar formalisms, express grammars in which the entire grammar consists of complex structures associated with individual words, plus some very simple general rules for combining these structures. In these lexicalized formalisms, each word can be thought of as a tree fragment; the full grammatical analysis of a sentence is formed by specifying how and in what order the fragments associated with each word in a sentence combine. In these grammar formalisms, the bulk of parsing a sentence is just deciding on which "part of speech" to assign to each word. Work at the University of Pennsylvania in viewing parsing as the selection of these "super parts of speech" has recently been very successful.

One new, very successful, class of parsing models uses conditional probabilities to model a rich range of linguistic structure. The first successful parser of this kind, developed by Magerman and myself, conditions rule probabilities on both the type of the immediately surrounding linguistic fragment, and the most likely part of speech assignments for each of the next two words in the input. This parser correctly parsed 89\% of a reserved test set from a simple human-computer interactive system for navigation driven from voice recognition, much improved from an accuracy of 35\% correct using the standard earlier model. Very recently, these results have been expanded by Magerman and others working with him at IBM and at BBN, achieving the parsing of Wall Street Journal text with 95\% of sentences receiving two or fewer parsing errors.

Most remarkably, these parsers operate with no hand-constructed grammar at all; they automatically extracts all information from a corpus of pre-parsed material. The most recent work is all trained on Penn Treebank, developed by the author. This treebank now consists of 5.5 million words of text hand tagged for part-of-speech, with about two-thirds of this material also hand annotated with a skeletal syntactic bracketing. This material has already been used for purposes ranging from serving as a gold-standard for parser testing to serving as a basis for the induction of stochastic grammars to serving as a basis for quick lexicon induction.

Lexical Semantics and Beyond

Initially, it would appear most unlikely that statistical techniques would be of much use for either the discovery or representation of the meanings of words. Surprisingly, a unsupervised training method has recently been devised, whose performance equals supervised methods, promising much less dependence on large annotated corpora of materials for training purposes. This opens up the possibility that NL components for languages other than English will become easy to develop, requiring primarily large collections of unannotated text.

Penn has now achieved word-sense-disambiguation results of 96.5\% correct using unsupervised training methods. Resolving word sense ambiguity requires determining the proper reading of a given word of text. This problem is crucial in lexical selection in language translation, in determining the correct pronunciations of homophonous words within a text-to-speech system, and in restoring accents in 7-bit ASCII encoded texts in languages such as French or Spanish. A new essentially unsupervised training method developed by Yarowsky achieves 96.5\% correct word-sense-disambiguation on a reserved test corpus. This algorithm requires only a standard dictionary definition for each of the two word senses as a seed.

In short, the shift in methodology within NLP is now producing robust system components which perform very well on unconstrained language tasks. These components, when used in environments of limited vocabularies and task complexities, should allow extremely low error rates, particularly with users who have become accustomed to system limitations.

WORKING GROUP REPORTS

BATTLE COMMAND BATTLELAB

In addition to discussing the three application areas considered by all of the working groups (training, assistance, and operational) this group also dealt with issues related to research, integration, and engineering.

Spoken Human-Machine Dialog Workshop 1995
Battle Command Working Group Findings
POC: CPT Kelly Lauritzen, Cliff Weinstein

Overview

Our working group focused on potential areas of future development in voice technology in three areas: training, assistance and operational applications.

Training Applications

Conversation is so wide ranging that it presents difficult in voice applications just be the sheer volume of possible utterances. Training applications have an advantage in that the application can often control and focus the conversation. It can proceed in a step by step manner in training the soldier. Here are several high pay-off areas:

Foreign language training: Foreign language specialists require training that is time and personnel intensive. Voice technology could help soldiers to practice interrogation, translation and working with coalition forces. It could also help foreign language specialists, who are in low density areas to maintain their language proficiency.

Classroom XXI: As the Army transitions to Classroom XXI, voice technology has a possible role in multimedia and distance learning. However, it is not clear how well matched it is to the environment. Since most classrooms are not simple querys and answers, but more complex interactions, this is an ill-defined area. It does appear that voice **output** will be important factor in Classroom XXI

Simulations: setting up training applications is a data intensive operation. It requires putting in units, routes, activities, etc. This could possibly be done better with voice. It also presents an interesting problem with the combination of voice with a graphical environment, since many military training applications focus on maps, map features and unit locations. Finally, in the military, we try to train as we fight, so these training systems are best when integrated into actual command and control systems.

Assistance Applications

We viewed information help services as the area with the most potential for the application of voice technology. Often when you need assistance, both your hands and eyes are occupied. Fixing an engine or radio, you might be in the middle of a procedure and suddenly need assistance or an answer to a question. Being able to ask the computer right then would save considerable effort. You could also include ordering procedures, so when you noted that you needed a part, you could ask the computer to help to identify the part number and then to order it. Because the domain is limited, you could limit the scope required for the grammar and vocabulary. Other help services could be offered over phone lines as is currently done on a limited scale. This same system could include voice authentication to control access.

A language based search aid, could help you in conversations in foreign languages. There are currently many foreign language aids, where you can type in the word in one language and see the translation. This same application would be much more efficient, if you could speak the word into the device and then **hear** what the translation is. These would be especially applicable in technical or military applications, where even a person who is quite proficient in a foreign language might not know the technical terms. This is intuitively obvious to most people because often native speakers have trouble listening to discussions with many technical terms. This would not only include single words, but idiomatic and common phrases.

Other assistance application possibilities are applications for controlling vehicles or devices. A Global Positioning System could warn you verbally if you strayed too far from a given route. It might also be used to control vehicles directly like an Unmanned Aerial Vehicle.

Operational Applications

Voice is the logical choice for Command and control on the move. When moving in a command and control vehicle cross country, it is impossible to use a mouse, keyboard or touch screen as an input device. Here noise is probably a major factor, but we noted that if the noise frequency range from the engines was outside of the voice range, it might not be so critical.

In the same way voice is suited for training in foreign languages, it also has potential as a translation device for Joint Forces. This would ease the need for trained language specialists and could provide a real time translation

Covert Operations often require overheading conversations and communications. This would include both natural language processing and voice recognition. If done successfully, it would facilitate continuous monitoring without being so labor intensive.

Voice Identify Friend or Foe. Currently, using challenge and password is a risky and dangerous operation. If you could improve voice matching technology, you could use a database as a security measure to identify personnel before admitting.

Engineering and Integration Issues

Voice applications often appear to be less successful than the technology actually is because people expect applications to be "smarter" with voice input. To get a truer picture, personnel using voice systems need to have familiar training in both the voice system and target application to be successful. This reflects the lack of robustness and lack of integration of artificial intelligence in voice technology. In other words, voice is viewed not only as an input, but a higher level of intelligence in the application itself.

A speech database for the military environment would be useful in testing. For example, there could be recording of radio transmissions to test recognition technology against the environment it would be used in. Other databases could be vehicle or weapon noise signatures.

Integrating a voice recognition system into another application requires more than just an efficient voice recognizer. The speech technologist, system contractor and government representative must establish a close working relationship. This is a project management note and does not relate directly to voice technology, but often has a dramatic effect on the success of the project.

Vocabulary and grammar must be easy enough to change and modify that the end-user can maintain or change them. Ultimately, a toolkit that would allow non-technicians to develop a grammar and vocabulary would be the best solution.

A major advantage of voice access is that it leaves the eyes and hands free to accomplish other tasks. This raises two issues: One, voice access must be mobile. If tied by a cable to a computer, users are much less likely to use voice technology because it would require donning and removing a headset. In addition, a user might want to query his computer while looking at a larger map display or when in another location. Because a "no tether" solution seems most desirable, investigating possible enemy interference wireless and infrared effect and countermeasures will be a future engineering issue. Second, in order to keep your hands free, voice technology with key words.

Training Applications

- o Air Traffic Control using simulators
- o Foreign Language Training
  - Interrogation
  - Translation/Transcription
  - Coalition Forces
  - Maintenance
- o Command Operations Training
  - Part of Multimedia lessons in Force XXI classroom
  - Not clear how well matched
  - Voice output important
- o Control and setup of simulations for wargaming
  - Leathernet
  - JANUS, CBS
  - Mission planning, Rehearsal, Training System
- o System Maintenance & Repair
- o Train as you fight
- o Training on voice systems which are to be integrated into C2 Systems

Assistance Applications

- o Maintenance of Radios
- o Maintenance & Debugging of information systems
- o Automated Help Desk
- o Automated Information Service
    - - All voice -- Jane's
    - - Authentication including voice for access control
- o Language-based information search aids
- o Advanced Language Assistants
    - - Technical
    - - Military
- o Direction Assistance
    - - Warning
- o Remote control
    - - UAV (Unmanned Aerial Vehicle)

Operational Applications

- o C2OTM
- o Phoenix
- o Translation for Joint Forces
- o Direction Finding
  - - GPS --> voice output
  - - Voice interrogation exercises
- o Covert/Adverse Operations & Communications
- o Voice IFF

R&D Issues

- Voice Recognition on wireless LANs
  - in C2Vs, for example
  - in TOC
- Grammar design and control
- Robust performance in noise and stress
- Soft or whispered speech
- Special Operations Forces (SOF)
- Wordspotting to get rid of PTT
- Jisting to make queries more flexible
  - Robust grammars
- Database creation & capture
- Toolkits
  - Techie
  - User
- Microphone Robustness
- Out-of-Phraseology Handling
  - Out-of-Vocabulary
  - User setting on confirmation
  - Rejection

Engineering & Integration Issues

- o Training in use of voice systems
- o Speech database collection for the environment
- o Integration of software based recognition technology in C2 systems
    - Phoenix
    - Speech Technologist/System Contractor/Government
- o Change and control of vocabulary & grammar
- o Flexibility & Tailorability
- o Toolkits (usable)
- o Ruggedness & EMI concerns
- o Different levels of human/machine interface
    - Engineer
    - Administrator
    - User
- o Mobility of voice access - no tether
    - wireless/infrared interference effect on recognition

MOUNTED WARFIGHTING BATTLESPACE

NUMBER: 1

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	MOUNTED WARFIGHTING BATTLESPACE.
EVALUATION AREA:	ASSISTANCE.
TITLE:	CONFIRMATION OF MESSAGE RECEIVED
ANALYST:	CHUCK CAMPBELL & MARTIN BOSEMER MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

The soldier is accustomed to initiating and responding to verbal communications more so than any other form of communication. The ability of a computer system to respond to voice communications is extremely important and critical to future force success and survivability in combat. This technology will also greatly enhance the effectiveness and efficiency of operations, training and administration. However, just as with humans, the soldier must ensure that the computer received the information and is going to react just as the sender intended. A simple "ROGER" as an immediate answer will not, in most cases, be an acceptable response to a verbal message given since there is no assurance that the computer made a proper interpretation of the message.

Effective, concise, and timely communications are critical to the order of battle and in every day actions. Commanders/leaders at all levels must be fully aware of the intent of a message received and must convey to the sender that the message was received, understood, and that the desired response will occur. Computer systems inherently have the ability to verify accurate receipt of data transmissions, detect and correct transmission errors with less than a 0.0000001 to 1 chance of error. However, computers today are only maintaining a 84% success rate for accurately interpreting fairly simple voice communications. With the capability of spoken human-machine dialogue, commanders, leaders, staffs will become party to increased volumes of simultaneous verbal communications which will become ever increasing emotionally sterile verbiage. Ensuring that the proper commands/actions/reactions are obtained and that the emotional characteristics of human communications are compensated for, will require an initial response more descriptive than "ROGER".

The desired voice response from a computer should contain information which ensures the sender that the receiver correctly heard the information and is going to provide the reaction desired by the sender. The communications from the computer must address which vocal information it is responding to and, in action summary form, inform sender of action to be taken. System must react to a "NEGATIVE" type statement to halt a reaction which was misinterpreted or to carry on with the acceptance of a default response statement similar to "ROGER " or "OK".

Spoken communications with a computer or group of computers is essential in maintaining pace with the ever increasing speed and volume of information. Although the average processing time of information has been drastically reduced over the past 20 years, the volume of information processed has increased at a greater relative rate. Spoken human-machine dialogue is the next step required to maintain the pace until direct interface with the human mined is attained.

Initial and continued importance must be placed on system development which will improve the capability of the computer to separate simultaneous voice traffic, identify which voice traffic it should respond to, provide short and logical responses to the sender ensuring the pending action is that desired by the sender, and waiting a short pre-determined period of time for a correction statement before accepting a default of "OK". Further value would be in the computers ability to analyze the voice pattern to ascertain the immediacy of the action as indicated by the volume and intensity of the voice or expletive used in the communication. The reduced time required for information entry by humans will certainly accelerate the volume of information processed. The greatest challenge to be faced with spoken human machine interface will be the dramatic increase in information processing and subsequent upgrades in computer systems for processing requirements since humans tend to over use systems which are easy to use. Will the time required for a computer or person to provide a logical response be acceptable? Probably not. In time the traditional "ACKNOWLEDGED", "ROGER" or "OK" will be commonly used as a response for most applications.

Application of spoken human machine dialogue is not a question of "if it becomes available", it's a question of "when will I be able to apply the technology to my needs?" Incorporation into training, operations, and administration can be accomplished easier and at a faster pace than incorporation into combat environments. Simply stated, the stable physical environment and repetitive nature of operations, training, and administrative tasks are normally easier and more cost effective to be adapted to this technology. Additionally, automation users are not balking at incorporating this technology, in fact there is high demand/desire for spoken interface to eliminate/minimize keyboard/video interface. Advances in spoken human machine dialogue are commonly occurring in banking, telephone systems, and other areas with great acceptance over the touch-tone key pad entry.

In summary, a descriptive confirmation of message received should be required at least until technology in artificial intelligence and voice pattern detection/separation improve to point where the confidence level in the computers ability to reason approximates or exceeds that expected of a highly trained and capable soldier.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations
(Circle One)

Title: COM message extraction, gisting, and screening

Concept: Develop the ability to screen messages for relevant communication, extract the desired and relevant information, and then gisting (summarizing) it and them transmitting it audibly or digitally.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
On the simplest level it would consist of searching the COM for word strings, and then play audio with relevant facts. Advanced would include context/intent level search at COM and then based current mission context. Summarize it to the desire present if when the pilot needs it.

Warfighting Merit: (Value added to Soldier)
It should substantially reduce workload of crewmen in tanks and helicopters and reduce the overall "chuttles" in the cockpit. By automating the scanning a computer could scan multiple channels for relevant data.

Current Projects: Unknown.

Required Research: Advanced development at implementing word seats in a COM environment (short term) (long term) would require complete development at a natural language capability (to include assessment of content and intent in real time). Since this technology would already include an understanding of contents and intent to do assessment, it should be easy to summarize information for crewmen or pilot.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] [✓ Assistance] [✓ Operations]

~~(Circle One)~~

Title: Confirmation of message received

Concept: When a human talks into a voice recognition system, the system must confirm that is heard what was said. Sometimes "Roger" is enough. Sometimes confirmation is needed that the message heard was what the human spoke. If a human speaks and many seconds pass without acknowledgment by the computer, the human tends to become frustrated.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Very easy to do. There are some interesting questions as to when to provide feedback by voice synthesis, when by screen display, when by other modalities; and, how the voice recognition system would decide whether to say "Roger" or to speak back exactly what it heard or to speak back a paraphrase. It seems likely that answering these questions on a case-by-case common sense basis will be adequate.

Warfighting Merit: (Value added to Soldier)
Increased human acceptability of voice recognition systems.

Current Projects: N/A. This is easy to do. Many systems do it. All need to.

Required Research: None seems needed.

NUMBER: 2

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	**MOUNTED WARFIGHTING BATTLESPACE.**
EVALUATION AREA:	**ASSISTANCE.**
TITLE:	**CAUTIONS, WARNINGS, AND ADVISORIES (CWA)**
ANALYST:	**CHUCK CAMPBELL & MARTIN BOSEMER** **MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045**

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

Computer generated cautions, warnings, and advisories are a vital aspect of technology today and in the future. Above all they must be respected as an integral part of the crew/platform interface and not perceived as a nuisance. CWAs are ever present operational, administrative and especially in training environments. However, interactive voice CWAs, which can answer analytical questions you pose after the initial CWA are required with emerging technologies. If you receive a low fuel warning, it would be logical to ask and receive response to how much is left, estimated distance supported, is consumption above normal level possibly indicating a leak, etc. CWAs must become interactive and analytical as they are included in future technologies to ensure success of future force projection and survivability during combat.

As most of us are aware, CWAs are ever present in our every day life from smoke detectors, various car warnings, and especially in the fast food industry. The common tone CWA is rapidly being replaced with voice CWAs. The car industry was one of the first industries to begin replacing non-critical tone CWAs with voice CWAs. Almost everyone respects a person who has little to say, but is eloquent, effective, and convincing when they do speak. To be successful, CWAs must also posses this quality as opposed to being perceived as an annoyance.

The system must be able to discern the criticality of the event and to adjust the voice output commensurate to the need for attention from the intended receiver. This "emotional" characteristic may not appear critical, however, one would anticipate that personnel subjected to long periods of monotone communications with a computer would loose valuable seconds in reacting at critical times. Efforts within aviation have proven that audible alerts must vary with the criticality of the situation to stimulate the crew into an enhanced reactive state. The merits of CWAs cannot be minimized. The relevant factor to the success of such systems is to determine on a varying scale, when CWA is needed and what intensity level of audio/visual CWA is needed to communicate the level of urgency.

System must also be sensitive enough to minimize/eliminate normal information which may become insignificant due to battle conditions or platform component loss. Crews/users are not concerned that a scheduled service is required due to miles or days when engaged in combat. The system should hold this type of information until a more reasonable time or information requested. This could be accomplished simply with a scaled over ride based on crews/users assessment of the mission mode and tempo. Finally the system cannot overburden the crew/user with constant information or the crew/user will mentally tune the system out if not physically turning the volume down or disconnecting the device, reactions typical to today's automobile CWAs. If you dislike the tone or voice, especially reminders to fasten your seat belt, disconnect it.

CWAs can be separated into three general categories of platform performance/environment (to include resource availability), external environmental conditions, and external threats. Within these three categories, CWAs can be classified as advisory or routine update, caution, warning, and imminent. CWAs are typical in today's technology but future technologies must posses the capability for interactive spoken human-machine interface. Adding voice interface will minimize visual sensory interruptions, such as an operator having to visually see gauges or setting/selections to identify a potential problems. However, a balance between visual and audio CWAs is critically important, especially during combat. While verbal CWA allows increased visual capabilities to monitor the threat, combat also brings additional voice communications both internal to the platform and external with which the CWA must compete for crew/user attention or may even become an unwanted interruption.

Although spoken human-machine dialogue is just emerging as an effective method of warning/problem identification and is only on the frontier of being dependable in the subsequent solution/resolution process, development and use will be essential in all future technology involving automation.

NUMBER: 3

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	**MOUNTED WARFIGHTING BATTLESPACE.**
EVALUATION AREA:	**ASSISTANCE.**
TITLE:	**COMMUNICATION MESSAGE EXTRACTION, GISTING, AND SCREENING.**
ANALYST:	**CHUCK CAMPBELL & MARTIN BOSEMER** **MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045**

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

The volume of communications, information, and data is increasing at an exponential rate. The U.S. has witnessed an unprecedented growth in data processing over the past twenty years. Managers no longer have the ability to review transaction ledgers, only summaries. We have evolved into a "BOTTOM LINE MANAGEMENT" age due to the ever increasing complexity and volume of information. With ever increasing volumes and types if information/data sources, computer systems commonly assimilate information into short answers. Communication message extraction, gisting, and screening is predominantly accomplished by administrative, operational, and staff personnel on a daily basis. In almost every environment, topics and bullet/paragraph supporting information is used when higher levels of management are being informed. Effective and concise communication message extraction, gisting, and screening will be required from spoken human machine dialogue and advanced artificial intelligence systems in future warfighting situations and mounted platform operations for successful combat/operational missions.

Automation is another area where summaries, gisting, screening, and extraction's are common. In most cases files/messages are not only given a name but also a subject, and summary of contents for potential viewers to scan for interest. Predominant on computer networks/bulletin boards is the ability to screen, scan, gist, to find information on a desired topic.

The system must be able to discern the criticality of the event and to adjust the level of detail provided commensurate to the need by the intended receiver. This "LOGICAL" characteristic may not appear critical, however, one would anticipate that personnel subjected to large quantities of information/data, over long periods of time, would loose the ability to maintain an overview of the situation. Efforts within aviation have proven that detailed platform system information must be available to the crew upon request, but the crews rely on the systems to provide summary information and critical warnings, alerts, and advisories based on previously defined parameters. With platform crew sizes diminishing, information/data increasing, future communication systems must possess the ability to screen, gist, summarize information/data if the platform, commander, trainer, mechanic, etc. are to be effective. They must be able to have variable control of the system sensitivity to attain the "appropriate level of information for the varying mission, environmental, physical, and combat environment".

The merits of communications gisting, extraction and screening cannot be minimized. The relevant factor to the success of such systems is to determine on a varying scale, when required and what intensity level of summary, etc. is needed to communicate the level of urgency. Systems must posses selective screening algorithms with user defined parameters, sensitive to both the perceived criticality of the sender and the receiver. Criticality level cannot be a simple numeric value, on the traditional 1 to 10 scale, which is established by the sender. A large percentage of the senders will be parochial and really believe their commo is a 10 without considering the complexity of the overall situation. On the other hand, the receiver may consider one small piece of information, which the sender considered a 1 to 3, the missing link in the picture. Every patient and sales person will tell the secretary/receptionist/nurse at the doctors office that they are the most important person the Doctor needs to see. What makes one think it would be different with computers. It appears that human screening, gisting, extraction will be required, assisted with computerized parameter theory systems, to process the preponderance of information/data until artificial intelligence meets requires standards for applicable missions.

Artificial intelligence, with variable parameters established by the user or system managers, is required to keep pace with today's information flow. The absence of artificial intelligence will be a critical limiting factor to future technological advances which minimize the size of human crews/staffs while increasing the amount and types of critical information to be received, processed, interpreted, reacted to, trained, or forwarded.

NUMBER: 4

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL: MOUNTED WARFIGHTING BATTLESPACE.
EVALUATION AREA: ASSISTANCE.
TITLE: ACCOMPLISHMENT OF ADMINISTRATIVE TASKS
ANALYST: CHUCK CAMPBELL & MARTIN BOSEMER
MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

Spoken human machine dialogue is a natural progression from keyboard entry systems. It will be a natural interaction to obtain information required for the preponderance of administrative tasks and to produce hard copy output. In future technology, written correspondence with signatures for authentication will be replaced by spoken human machine dialogue using a voice print for a higher level of verification/authentication. This technology will revolutionize the administrative processes of today, if not achieved, current administrative methods will rapidly become too slow for processing the flow if information/data which will have a devastating impact in combat. History has documented and criticized many instances where poor administrative capabilities were the predominant factor in mission failures. Example of such a critical administrative delay was that in which the Japanese Ambassador to the U.S. was late in delivering the Japanese declaration of war on the U.S. prior to the bombing of Pearl Harbor.

Sever backlogs in information input systems was a significant problem to the banking industry in the late 70s. Huge backlogs in information input and verification systems frequently caused over four days delay in processing check/credit card transactions if local and over five if outside the region. Now electronic point of sale interface with the financial clearing systems identify funds for transfer immediately at the time of sale. Without this improvement in the system. Soon your automatic teller may not require a card, just your voice and security information.

This technology will revolutionize administrative systems. As we move further toward a paperless environment we must also move towards a keyless environment. Spoken human machine dialogue is just the next logical step required towards direct mental interface between humans and machines. Our views of current administrative duties must be replaced with the vision of a small wireless headset/ear device and microphone, which are capable of independently determining which voice data is intended for transmission, destination(s) desired, additional data to be attached to transmission, most effective and economical method of transmission, security/encryption levels required, interpretation of information originating in a language other than the users, and automatic switching/multi-channel simultaneous routing of information.

The financial, legal, and proof positive requirements have generated an immense requirement for every profession to produce and maintain large volumes of "hard copy documentation". Instilling a sociological reform towards "hard copy documentation" will be the greatest challenge in the emergence of this technology within administrative areas. As an example, the technology of manually typed transcription/recording services, commonly used in court rooms, are being parallel with court cameras and recording devices, but not replaced. Courts still require court recorders. Until voice recognition systems, high volume data storage, enhanced information retrieval systems, and of most importance relational network interface systems for information sharing/routing are perfected and accepted as an "OFFICIAL RECORD", benefits will be comparatively minimum.

The financial, legal, and proof positive requirements have generated an immense requirement for every profession to produce and maintain large volumes of "hard copy documentation". Instilling a sociological reform towards "hard copy documentation" will be the greatest challenge in the emergence of this technology within administrative areas. As an example, the technology of manually typed transcription/recording services, commonly used in court rooms, are being parallel with court cameras and recording devices, but not replaced. Courts still require court recorders. Until voice recognition systems, high volume data storage, enhanced information retrieval systems, and of most importance relational network interface systems for information sharing/routing are perfected and accepted as an "OFFICIAL RECORD", benefits will be comparatively minimum.

Once the spoken human machine dialogue administrative methods are perfected and accepted, the frustration of "paperwork" associated with job performance will become minimal. In addition, information will be less subject to error based on multiple transcriptions. Future technology will not be able to emerge without the incorporation of spoken human machine dialogue in the administrative areas.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations
(Circle One)

Title: Accomplishment of Administrative Tasks

Concept: Input and query of personnel data, maintenance, etc., by voice recognition..

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Desired: Update and query by voice rather than key-in.

Warfighting Merit: (Value added to Soldier)
Faster input of information, so fewer soldiers needed for administrative task. No need for soldiers to learn to be good typists in order to perform administrative tasks.

Current Projects: COTS tools are now available for controlling forms-oriented inputs that have highly restricted syntax.

Required Research: None seems needed.

NUMBER: 5

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	MOUNTED WARFIGHTING BATTLESPACE.
EVALUATION AREA:	ASSISTANCE.
TITLE:	ADVANCES IN VOICE SYNTHESIS
ANALYST:	CHUCK CAMPBELL & MARTIN BOSEMER MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

Voice synthesis, in the development of spoken human machine dialogue, is a critical factor to the overall success of future systems. The immense complexity of developing a system that not only recognizes voice generated sounds from an environment with a multitude of various sounds, but also detects which language and dialect is being spoken is recognized as ambitious but necessary. The translation process would appear simple once the language and dialect identification process is completed. Generating a response from the computer would be considered easier since the language and dialect of the receiver would probably be known or given as a known variable.

The true warfighting merit of voice synthesis is in how the machine developed voice conveys the seriousness of the information being presented. The voice synthesis process cannot be monotone and at the same level or the receiver will become less responsive. There must be an "emotional" quality to the output to be considered an effective crew member. With the capability of spoken human-machine dialogue, commanders, leaders, staffs will become party to increased volumes of simultaneous verbal communications which will be emotionally sterile verbiage. Ensuring that the proper commands/actions/reactions are obtained and that the emotional characteristics of human communications are compensated for, voice synthesis will initially have to be more descriptive than normal human communications. The desired quality of voice synthesis could be attained if the computer had the ability to analyze the voice pattern to ascertain the immediacy of the action as indicated by the volume and intensity of the voice or expletive used in the communication.

In summary, humans will have to verbalize the criticality of the information being presented at least until technology in artificial intelligence and voice pattern detection/separation improve to point where the confidence level in the computers ability to reason and express emotional characteristics approximates or exceeds that expected of a highly trained and capable soldier.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] [✓ Assistance] Operations
(Circle One)

Title: Advances in voice synthesis

Concept: Develop fieldable technology that provides man natural and intelligible synthesis of speech by computer.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
- Take into account discourse context in shaping information patterns.
- More accurately represent idiosyncrasies of English pronunciations.

Warfighting Merit: (Value added to Soldier)
- Adds to training application (SAFOR).
- Makes computer output more intelligible in noisy environment.

Current Projects:
- COTS available but doesn't sound natural.
- e.g. Barbara Gross experiments in using discourse knowledge in speech synthesis
- Armstrong Labs ongoing intelligibility studies

Required Research:
- Discourse context representations and influence in prosody.
- Bigger databases of word pronunciation in English.
- Something to make audio output more human-like.

These cut across concepts: Re-use
Accessibility (Modifiable at local (end)
Human Factoring

NUMBER: 6

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	MOUNTED WARFIGHTING BATTLESPACE.
EVALUATION AREA:	ASSISTANCE.
TITLE:	REFERENCE ACCESS
ANALYST:	CHUCK CAMPBELL & MARTIN BOSEMER MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

Reference access is essential to developing outstanding training and operations programs. The ability to attain related information on a subject, in a verbal discussion, allows for a more consistent interactive question and answer session , minimizing the traditional interruptions and countless trips to various sources of information. Of greater importance operationally, is the ability of the soldier to obtain reference material in the maintenance world without having to move from his/her position. The increased ability for the super technicians maintaining this advanced equipment will only be limited by their ability to access technical information. The amount of information required for technical maintenance will far exceed the ability of the human mind to retain. In addition, with a smaller army, the technicians have been absorbing more and more systems to maintain within their MOS. Spoken human machine dialogue will achieve it's greatest impact within the interaction of reference information and assisting in determining a known outcome before the soldier proceeds with intuitive maintenance or operational operations ("what happens if I do this?").

The ability to quickly reference information systems will be of immeasurable assistance to platform crew members as they have to perform field expedient repairs. The computer can in fact lead them step by step through the problem analysis and identification phase on through the actual repair phase. This ability, if information availability exists will enhance the operational capability, survivability, and sustain ability of any mounted platform.

The uses are limitless in the training program, especially with remedial and individual paced programs. This one-on-one environment/interface can adapt to the logic and thought patterns of the student ,without the frustration, based on the questions the student poses to the system. To the system there are truly no dumb questions.

The ability to ask a question, and to have a computer research various sources for the information, and to be able to discuss the findings, or have any analytical functions performed with the information available, in a hands free mode, will have immeasurable positive impacts on the combat, operational, and training capabilities of the Army.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations

(Circle One)

Title: Reference Access (Spoken Natural Language Reference Access to Manuals, etc. Orders)

Concept:
- Easier crew access to complicated, obtuse manuals
- Step-through diagnosis and repair from manuals

Technical Assessment: (Desired Capabilities, Current Shortfalls)
- Must have manuals digitized and in computer-accessible form.
- Fairly broad vocabulary natural language processing

Warfighting Merit: (Value added to Soldier)
- More knowledge available to soldier as needed
- Decreased reliance on specialists
- Allows hands-busy eyes busy access to knowledge
- Save space
- Permits easier updates
- Multimedia (voice/sound/video/picture)

Current Projects:
- Some work being done in digitizing manuals, Air Force flight control systems
- Dialogue, NLP, voice research

Required Research:
- Designing format for storing manual knowledge
- Design semantics, grammar for accessing this knowledge using NLP.
- Make updating easy/automated.

NUMBER: 7

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	**MOUNTED WARFIGHTING BATTLESPACE.**
EVALUATION AREA:	**ASSISTANCE.**
TITLE:	**VIRTUAL CREW MEMBER**
ANALYST:	**CHUCK CAMPBELL & MARTIN BOSEMER** **MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045**

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

The virtual crew member is an absolute requirement which we are slowly evolving towards with today's technology. Technology has provided for many sophisticated independent systems which are evolving from fixed program based systems to developed logic based systems which approach artificial intelligence. The virtual crew member is one that appropriately responds with the correct action/reaction within less time, at greater efficiency, and at a level exceeding a well trained and seasoned veteran soldier while interfacing well with other crew members. The virtual crew member should also be a single source of information integration from independent platform systems. Every system should operate independently so damage to one system will have a minimum impact on other systems. The virtual crew member should not only perform certain functions, such as the loaders position on a tank (intelligent autoloader), but should also be able to integrate information exchange between all platform systems.

The ability to quickly evaluate the functional status of platform systems and to quickly attain reference material will be of immeasurable assistance to platform crew members as they have to perform field expedient repairs. The computer can in fact lead them step by step through the problem analysis and identification phase on through the actual repair phase. This ability, based on independent systems information connectivity, will enhance the operational capability, survivability, and sustainability of any mounted platform.

It is essential that the virtual crew member have spoken human machine dialogue capability. The soldier is accustomed to initiating and responding to verbal communications more so than any other form of communication. The ability of a computer system to respond to voice communications is extremely important and critical to future force success and survivability in combat. The desired voice response from a computer should contain information which ensures the sender that the receiver correctly heard the information and is going to provide the reaction desired by the sender. The communications from the computer must address which vocal information it is responding to and, in action summary form, inform sender of action to be taken. System must react to a "NEGATIVE" type statement to halt a reaction which was misinterpreted or to carry on with the acceptance of a default response statement similar to "ROGER " or "OK".

The virtual crew member should be the central processing system for computer generated cautions, warnings, and advisories (CWA). CWAs are ever present operational, administrative and especially in training environments. However, interactive voice CWAs, which can answer analytical questions you pose after the initial warning are required with emerging technologies. If you receive a low fuel warning, it would be logical to ask and receive response to how much is left, estimated distance supported, is consumption above normal level possibly indicating a leak, etc. CWAs must become interactive and analytical as they are included in future technologies to ensure success of future force projection and survivability during combat. The inherent ability of future systems must include those capable of performing an immediate logical analysis of CWAs, not only for verification, but to act immediately from multiple sensor input or to provide an immediate impact assessment and provide options available to the crew.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations
(Circle One)

Title: Virtual Crewmembers

Concept: In training/simulation, a platform member works w/virtual crewmembers to carry out an objective.

Technical Assessment: (Desired Capabilities, Current Shortfalls)

Warfighting Merit: (Value added to Soldier)
-- Low cost training

Current Projects:

Required Research:
-- Context study (What do crewmembers say? How do they interact?)
-- Interface artificial agents (expert systems) w/training simulator
-- Support necessary NLP

NUMBER: 8

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	MOUNTED WARFIGHTING BATTLESPACE.
EVALUATION AREA:	ASSISTANCE.
TITLE:	CREW STATION ENHANCEMENT
ANALYST:	CHUCK CAMPBELL & MARTIN BOSEMER MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

Crew station enhancements will be inherent with the incorporation of spoken human machine dialogue. Any time you can minimize the time a crew member has to move eyes from the field or function being performed, especially during combat, you increase the effectiveness and survivability of the platform crew. Within a tank system, being able to verbally have the autoloader switch from sabot to heat and the switch at the gunners station automatically switch from sabot to heat, and the sighting systems automatically adjust, will allow the gunner and tank commander to concentrate on the target(s), vice requiring thought and movement to switch. This incorporates the virtual crew member as an absolute requirement which we are slowly evolving towards with today's technology. Technology has provided for many sophisticated independent systems which are evolving from fixed program based systems to developed logic based systems which approach artificial intelligence. Crew station enhancement is the virtual crew member, one that appropriately responds with the correct action/reaction within less time, at greater efficiency, and at a level exceeding a well trained and seasoned veteran soldier while interfacing well with other crew members. The virtual crew member should also be a single source of information integration from independent platform systems. Every system should operate independently so damage to one system will have a minimum impact on other systems. The virtual crew member should not only perform certain functions, such as the loaders position on a tank (intelligent autoloader), but should also be able to integrate information exchange between all platform systems.

The ability to quickly evaluate the functional status of platform systems and to quickly attain reference material will be of immeasurable assistance to platform crew members as they have to perform field expedient repairs. The computer can in fact lead them step by step through the problem analysis and identification phase on through the actual repair phase. This ability, based on independent systems information connectivity, will enhance the operational capability, survivability, and sustainability of any mounted platform. This capability will be of immense importance to any crew member at any station.

Spoken human machine dialogue capability will, in it's self, improve crew station effectiveness since the soldier is accustomed to initiating and responding to verbal communications more so than any other form of communication. The ability of a computer system to respond to voice communications is extremely important and critical to future force success and survivability in combat. The greatest crew station enhancement is the analytical ability afforded to the crew members by a "virtual crew member".

The virtual crew member should not only be the central processing system for performing explicit functions normally performed by a crew member. It must become the interactive and analytical interface between all platform systems and the platform crew to ensure success of future force projection and survivability during combat. The inherent ability of future systems must include those capable of performing an immediate logical analysis of cautions, warnings, and alarms, not only for verification, but to act immediately from multiple sensor input or to provide an immediate impact assessment and provide options available to the crew.

Crew station enhancements made available through spoken human machine interface are composite enhancements. Many improvements will occur, at various times, improving the environment of the crew member. We must accept the fact that in today's Army, the size of crews are becoming smaller while the platform capability and technology continues to increase. This is putting an increased broad and in-depth technological knowledge requirement on fewer crew members, requiring faster actions/reactions of those members. The future effectiveness and survivability of future platforms will require effective interaction between man and machine. Spoken human machine dialogue is the next step in technology required towards direct mental human machine interface.

NUMBER: 9

SPOKEN HUMAN-MACHINE DIALOGUE WORKSHOP

PANEL:	**MOUNTED WARFIGHTING BATTLESPACE.**
EVALUATION AREA:	**ASSISTANCE.**
TITLE:	**DICTATION OF PLANS, ORDERS, AND DIRECTIVES**
ANALYST:	**CHUCK CAMPBELL & MARTIN BOSEMER** **MBBL, FORT KNOX, KY 40121 DSN: 464-1963/2045**

WARFIGHTING MERIT (VALUE ADDED TO SOLDIER)

The volume of communications, information, and data is increasing at an exponential rate. The U.S. has witnessed an unprecedented growth in data processing over the past twenty years. Managers no longer have the ability to review transaction ledgers, only summaries. We have evolved into a "BOTTOM LINE MANAGEMENT" age due to the ever increasing complexity and volume of information. With ever increasing volumes and types if information/data sources, computer systems commonly assimilate information into short answers. Communication message extraction, gisting, and screening is predominantly accomplished by administrative, operational, and staff personnel on a daily basis. In almost every environment, topics and bullet/paragraph supporting information is used when higher levels of management are being informed. Effective and concise communication message extraction, gisting, and screening will be required from spoken human machine dialogue and advanced artificial intelligence systems in future warfighting situations and mounted platform operations for successful combat/operational missions.

Spoken human machine dialogue is a natural progression from keyboard entry systems. It will be a natural interaction to obtain information required for the preponderance of administrative tasks and to produce hard copy output. In future technology, written correspondence with signatures for authentication will be replaced by spoken human machine dialogue using a voice print for a higher level of verification/authentication. This technology will revolutionize the development/issuance process for plans, orders, and directives . If the current process is not dramatically improved, current methods will rapidly become too slow for processing the flow if information/data which will have a devastating impact on daily operations and in combat.

Spoken human machine dialogue must revolutionize current concepts of effective command systems. As we move further toward a paperless environment we must also move towards a keyless environment. Spoken human machine dialogue is just the next logical step required towards direct mental interface between humans and machines. Our views of current methods of manually developing plans, orders, and directives must be replaced with the vision of a small wireless headset/ear device and microphone, which are capable of independently determining which voice data is intended for transmission, destination(s) desired, additional data to be attached to transmission, most effective and economical method of transmission, security/encryption levels required, interpretation of information originating in a language other than the users, and automatic switching/multi-channel simultaneous routing of information. These systems must also be able to process spoken input as visual output in multiple formats such as character, graphic, digital, etc.

The financial, legal, and proof positive requirements have generated an immense requirement for every profession to produce and maintain large volumes of "hard copy documentation". Instilling a sociological reform towards "hard copy documentation" will be the greatest challenge in the emergence of this technology within command and related administrative areas. As an example, the technology of manually typed transcription/recording services, commonly used in court rooms, are being parallel with court cameras and recording devices, but not replaced. Courts still require court recorders. Until voice recognition systems, high volume data storage, enhanced information retrieval systems, and of most importance relational network interface systems for information sharing/routing are perfected and accepted as an "OFFICIAL RECORD", benefits will be comparatively minimum. Transcription of plans, orders, and directives may occur through spoken human machine interface, buy technologically speaking, this will only be a minor improvement when one envisions the total process.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] Assistance Operations
(Circle One)

Title: Mission Training with Simulated Forces.

Concept: When semi-automated (simulated) forces are an important part of a mission training exercise, the need for realism is important. The officer being trained (for example, a battalion commander) should be able to communicate with simulated subordinates in the same way he would communicate with real subordinates. This means human-machine dialog over a simulated radio.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Desired capabilities include the ability of semi-automated forces (SAFOR) to understand the small subset of natural language that is relevant to military commanders sending short orders to subordinates; the ability of SAFOR to generate synthesized voice output; the ability (for the sake of realistic training) to generate simulated radio static and crosstalk; the ability to recognize voice utterances in spite of static and crosstalk.

Warfighting Merit: (Value added to Soldier)
The value is, first, increasing the level of realism when training with SAFOR. Secondly, voice communication between the training audience and the SAFOR will reduce the need for expensive support personnel to make SAFOR simulations run properly.

Current Projects:
In the Modular Semi-Automated Forces (MODSAF) simulation being developed by ARPA (armored battalion level training), an experiment with voice communication is being conducted by STRICOM. The work is being done at MITRE.

Required Research:
Robust voice recognition (especially with respect to background noise) is essential. Second, currently available GTS voice recognition systems often do not make available in their output enough information to enable Natural Language Processing to detect and correct single-word recognition errors. Doing this is currently feasible, but pressure needs to be applied to GTS vendors to get them to do it. Third, research is needed to classify the kinds of dialogs that commanders and their subordinates actually have over real commo channels (currently radio), so that SAFOR can take part in such dialogs.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] Assistance Operations
(Circle One)

Title: Integration of training, assistance, and operational spoken human-machine interfaces.

Concept: Develop and integrate natural language program so that the same program (or at least same interface) is used in both training of crewmen and maintenance personnel and would act as an assistance in the field and could be accessed at C&C level for operational design.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Current interface are all designed for a specific function/application. Since the same knowledge is required for levels (only how it interfaces) with the individual charges. Natural language processing would be a key component in the interface, especially as it can easily transcend different platform (or interface level). .

Warfighting Merit: (Value added to Soldier)
Would promote commonality access training and deployment. Should reduce overall development cost since it would eliminate duplication of effort required for developing 3 different systems.

Current Projects:
Unknown.

Required Research:
Extremely high level at integration is required not only to make sure that is combines all the interfaces into a unified product but also integrates correctly with other programs the system must work with at each level of deployment.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] Assistance Operations
(Circle One)

Title: Automated evaluator for training system speech recognition - complex tasks

Concept: Use of speech recognition to score students or simulation task performance in place of human evaluator to automate evaluation process. For example, student needs to make site report. Use speech recognition to evaluate accuracy of site report.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
High accuracy, continuous speech recognition technology.

Warfighting Merit: (Value added to Soldier)
Reduced personnel for evaluating students

Current Projects:
Air Force program called SECT -- Student Electronic Combat Trainer is using ITT speech recognition to evaluate students during EW training.

Required Research:

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

[✓ Training] Assistance Operations
(Circle One)

Title: Tutoring Maintenance

Concept: Student can speak to "articulate expert" in a VR simulation for tank maintenance. Student poses questions ("Why x?") and teaching requests ("Show me X") and expert responds.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Continuous speech recognition of limited domain questions, natural or open syntax (as in Air Travel Information System Task). Use topic spotting of natural language processing to aid interpretation of questions. Current technology does not integrate NLP and higher knowledge with CSR.

Warfighting Merit: (Value added to Soldier)
-- Improved training of tank (and other ground platform), maintenance for tank and platform crew will reduce reliance on logistics base, so increase time task available for battle operations.
-- Architecture can be reversed for other kinds of tutors.

Current Projects:
-- Duke University tank maintenance incorporates VR and tutor architecture.
-- MITRE experiments on NLP-CSR integration (also SRI, BBN).
-- CSR research push beyond current COTS level (eg CHU, SRI).
-- BBN articulate experts for maintenance of Hawk ADS.

Required Research:
-- Model dialogues between real students and tutors.
-- Develop NLP/dialogue planning/processing modules
-- Develop expert knowledge base
-- Refine CSR technology and integrate NLP.
-- Integrate with articulate expert and VR simulation

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training Assistance [✓ Operations]
(Circle One)

Title: Real time information management through voice query

Concept: Use of voice recognition to rapidly query on-board (battle) mission management/information management computer system to retrieve mission critical information. Intelligent filtering of data into useful information, i.e. threat position.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Natural Language data base query methods. High accuracy, robust speech recognition in noise, vibration environment.

Warfighting Merit: (Value added to Soldier)
Improved situation awareness, increased surviability.

Current Projects:

Required Research:
Basic research in improving speech recognition in severe environments.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training Assistance [✓ Operations]
(Circle One)

Title: Command and control on the move

Concept: Allow full, clear and distinct use of command and control systems while operating on the move. Must operate within the platform environment.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Must filter any background noise, vibration, shock of weapons firing and other system operating distracters while crew is operating under stress.

Warfighting Merit: (Value added to Soldier)
Allows rapid, accurate transmission of command and control plans, orders and directives.

Current Projects:

Required Research:
Ability to have speech recognition with built in responses that commands are understood.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training Assistance [✓ Operations]
(Circle One)

Title: Control of robotics

Concept: Voice actuated command and control of robotics platforms, air and ground, in reconnaissance or mine/obstacle clearance.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Ability to voice control a platform from a remote, semi-secure position. Systems are now teleoperated and have very cumbersome, resource demanding control system.

Warfighting Merit: (Value added to Soldier)
Can save soldier lives. Permits better utilization of resources, assists in the maintenance of battle tempo.

Current Projects:

Required Research:
Voice activation of systems that will allow navigation and control of platform systems.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations
(Circle One)

Title: Cautions, Warnings and Advisories (relevant information pertaining to internal and external imminent threat)

Concept: Improve platform caution, warning and advisory alerting system through intelligent application of voice warning techniques in place of tones, and lights.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Use of voice output for CWA must be intelligently applied to minimize false alarms and to not compete with other tasks requiring high aural attention unless the warning is immediate and potentially life threatening. Avoid the "Bitchin Betty" implementation.

Warfighting Merit: (Value added to Soldier)
Enhanced crew awareness of threat warnings and system malfunctions.

Current Projects:

Required Research: Development of intelligent prioritization schemes for voice communication of cautions, warnings, and advisories.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations

(Circle One)

Title: Dictation of plans, orders and directives

Concept: Commander voice dictates orders, plans, directives into system. System formats, adds graphics and prepares to transmit digitally.

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Ability to prepare/format orders, plans and directives.

Warfighting Merit: (Value added to Soldier)
Maintains battle tempo.

Current Projects:

Required Research:
Requires speech recognition; natural language processor.

Spoken Human-Machine Dialogue Workshop

Panel: Mounted Warfighting Battlespace

Training [✓ Assistance] Operations
(Circle One)

Title: Crew Station Enhancement: Extended Reach of the Crewmember

Concept: Give crew members "infinite reach" through spoken natural language. Can access equipment, information w/out physically moving to location. Warnings, advisories spoken. .

Technical Assessment: (Desired Capabilities, Current Shortfalls)
Spoken language interface to platform systems
Shortfalls -- many platform functions not electronically accessible
-- fairly broad vocabulary

Warfighting Merit: (Value added to Soldier)
Crew members can do more, in less time, simultaneously.

Current Projects:

Required Research:
Must be extremely reliable.
Handle all sorts of noise.

COMBAT SERVICE SUPPORT

CSS Applications of SHMD

The CSS panel felt that the application of SHMD should be viewed more as a continuum between training, assistance, and operations vice distinct areas. The primary rationale for this viewpoint is that we should train as we fight. For the purpose of this summary the potential applications are discussed separately.

Training Applications:

The CSS panel discussed five training applications of SHMD: (1) learning the Army language, (2) sustainment training, (3) training on the use of expert systems, (4) load plan training, and (5) natural language for distributed interactive simulations.

SHMD could be used to teach entry level soldiers the Army s language. This would include learning the mission specific language, acronyms, and vocabulary. Such a system would decrease the time it takes to integrate a new soldier into the Army.

A voice recognition, interactive system could be used for sustainment training for various Standard Army Management Information System (STAMIS). The panel recommended starting with the Standard Army Retail Supply System - Objective (SARSS-O).

The third training application is to use SHMD do supplemental training in the use of expert systems by using voice input and output. This would permit a rapid training on the use of the expert system.

SHMD could be used to training the CSS community on how to load ships, rail cars, and planes without wasting space. The current system for training doesn t provide the feedback to the soldier on how well the space was used. Such as system would permit faster more efficient stow plans.

The final training application was to use natural language inputs and outputs with distributed interactive simulations. The concept would be for the system to provide information on the location of the closest supply point or maintenance facility during a distributed interactive simulation exercises.

Assistance Applications:

The CSS panel came up with seven assistance applications: (1) integrated electronic technical manuals, (2) field services (mortuary affairs), (3) back seat driver, (4) Explosive Ordinance Disposal (EOD) disarming, (5) Standard Army Management Information System (STAMIS), (6) voice print for supply distribution, and (7) natural language for doctors.

SHMD could be used to replace technical manuals with wearable computers and use natural language as an input device which is augments virtual reality with voice. Such a system could eliminate the second soldier who now reads the technical manual to a soldier who is inside the tank. It would also reduce the space and weight of paper technical manuals. It could also reduce the training requirements and the IQ requirements for maintainers.

A voice activated system that would provide latitude and longitude data for the location and operational procedures when recovering remains was one of the assistance uses for SHMD.

The back seat driver would provide assistance to the driver on navigation, fuel required to get to a certain location and driving in blackout conditions.

The EOD disarming would use a intelligent knowledge based system to assist in bomb disposal training and disarmament for conventional ordinance.

A interactive systems starting at the unit level through the division into corps would provide diagnostic procedures indicating the status as well as evacuation procedures through maintenance activities as well as repair part requisitioning to include voice query.

A voice print could be used to provide verification of individual receiving supplies. This would permit the rapid receipt of supplies.

Natural language could be used to assist medical doctors either during an operation or in diagnosis of an illness. Dictation could be used to input to medical records.

Operational Applications:

The CSS panel come up with three operational applications: (1) Nuclear, Biological and Chemical (NBC) detection, (2) voice activated radio frequency (RF) tags, (3) environmental warfighting suit.

A voice capability that could be added to the Chemical Detect alarm system that will tell the user what agent was detected was identified as a needed capability.

Another operational application of SHMD is for a voice activated RF tag. This tag would provide voice response to spoken queries concerning container contents in include consignor and consignee.

The final operational application was for an environmental warfighting suit. The uniform would consist of sensors and environmental awareness data with voice query and recognition.

CSS Application of SHMD

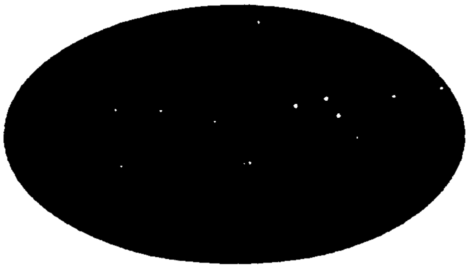
CSS
Applications
of
Spoken Human- Machine Dialogue

Research Areas

- Speaker independent
- Noisy environments
- Statistical models of language including dialogs
- Integration of structural information in language
- Multilingual systems

Bottom line - Need to move out and use SHMD now!

SHMD CSS Relationships



Training Applications

1. Learning the Army language.
2. Sustainment training.
3. Training on use of expert systems.
4. Load Plan Training.
5. NL for Distributed Interactive Simulation.

Learning the Army Language

- Mission specific language
- Acronyms
- Vocabulary

Sustainment Training for Standard Army Retail Supply System Objective (SARSS-O)

- Input / output
- Maintain skill level

6/1/95

CSS Application of SHMD

Training on use of Expert Systems

- Supplement with voice

Load Plan Training

- Current models are for operation
- Feedback on wasted space

NL input and output into Distributed Interactive Simulation (DIS)

- Find supply point
- Find maintenance facilities
- Ammo and fuel updates

Assistance Applications

1. Integrated Electronic Tech Manuals
2. Field Services (Mortuary Affairs)
3. Back Seat Driver
4. EOD disposal
5. STAMIS
6. Voice print for supply distribution
7. NL for doctors

Integrated Electronic Technical Manuals

- Wearable computer
- Augment virtual reality with voice
- Reduce paper manuals

Field Services (Mortuary Affairs)

- Position location of remains
- Procedures for recovering remains

5/31/95

CSS Application of SHMD

Back Seat Driver

- Assistance to find location
- Night driving (blackout)

Explosive Ordnance Disposal (EOD) disarming

- Bomb disposal
- Disarmament of conventional ordnance

Voice Input to STAMIS

- Unit through Corps
- Diagnostic procedures
- Maintenance procedures
- Requisitioning procedures

Voice print for supply distribution

- Voice ID for receiving supplies
- Need major breakthrough

NL Assistance to Doctors

- During operations
- Making diagnosis

Operational Applications

1. NBC detection
2. Voice activated RF tags
3. Environmental Warfighting Suit

5/31/95

CSS Application of SHMD

Voice Activated RF Tags

- Container contents

NBC Detection

- Voice alarm
- Integrate detection, analysis and alarm

Environmental Warfighting Suit

- Every soldier a sensor
- Voice dialog

5/31/95

Required Research

(Preamble)

Research in the past 10 -15 years have led to several technologies in Speech and Language that are now ready to be deployed in many application areas for the Army - in training, assistance, and operational.

What are the areas of research that need further development in the next 10 - 15 years which will lead to new technologies that will only improve on the applications described earlier but open up new applications.

- Further work on speaker independent systems
- Speech systems that work effectively in very noisy environments
- Statistical models of language including dialogs
- Integration of statistical structured information in language
- Multilingual systems for multilingual environments

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Training)

Title: Sustainment for Standard Army Retail Supply System - Objective (SARSS-O)

Concept: Voice recognition interactive system for sustainment training- For logistics within theater through Depot to include SAVI Tag Recognition

Technical Assessment:

Warfighting Merit: Provide method to maintain skill level on Standard Army Management Information Systems (STAMIS)

Current Projects:

Required Research:
- Ambient Noise resistant systems
- Speaker independent systems

POC Karlo Aguilar

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Training)

Title: NL input and output into Distributed Interactive Simulation (DIS)

Concept: Have the system provide information on location of closest supply point or maintenance facility during a DIS training exercise. Could also provide ammo and fuel updates.

Technical Assessment: Would like to be able to ask the computer where the closest supply point is, etc. Computer will analyze system messages and provide answer.

Warfighting Merit: To be used in DIS training exercises using virtual reality.

Current Projects: STOWE, SIMNET

Required Research: Dialog systems

POC Miranda Moore

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Training)

Title: Learning the Army language

Concept: Use NL to teach entry level soldiers the Army's language. This would include learning the mission specific language, acronyms, and vocabulary.

Technical Assessment:

Warfighting Merit: Would decrease the time it takes to integrate a new soldier into the Army.

Current Projects:
None

Required Research:

Speaker independent systems

POC Mary Lee Johnson

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Training)

Title: Training on the use of Expert systems

Concept: Training on how to use expert systems should be supplemented with voice input and output.

Technical Assessment: Replace written dialogue with voice.

Warfighting Merit: More efficient and easier to understand and would quickly train the user on the expert system.

Current Projects:

Required Research:

Dialog systems

POC Miranda Moore

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Training)

Title: Load Plan Training

Concept: Natural language providing feedback on wasted space on a ship/railcar/plane etc. to train to more efficiently load a ship.

Technical Assessment: Ship stowplanning systems today do not train to load more efficiently, they provide an automated capability to build a stow plan. Assessment of stow plan would be useful for training to load a ship.

Warfighting Merit: Faster more efficient ship stow plans.

Current Projects: CAEMS, ICODES

Required Research: Interfacing optimization or simulation routines that can analyze stow plans to speech language systems.

POC Miranda Moore

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Integrated Electronic Tech Manuals (IETM)

Concept: Replace paper Tech manuals with wearable computers and use NL as an input device. Augment virtual reality with voice.

Technical Assessment: Speech recognition and understanding needs to improve. Must approach that of humans.

Warfighting Merit:

1. Eliminates the second soldier who now reads the Technical manual to the hands on soldier who is inside a tank.
2. Reduce space and weight of paper Technical manuals.
3. Reduce the training requirement and the IQ requirement.

Current Projects: IETM for Paladin/AFAS/Crusader

Required Research:

- Ambient noise resistant systems
- Dialog systems

POC Edward Greisch

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Field services (Mortuary affairs)

Concept: Voice activated system that would provide Latitude/Longitude data for location together with specific operational procedures when recovering remains.

Technical Assessment:

Warfighting Merit: Efficient recovery operations

Current Projects:

None

Required Research:

POC Karlo Aguilar

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Back seat driver

Concept: Provide assistance to the driver. Using voice the driver could ask for assistance, for example, like how to get to a location, how much gas is left or required to get to a certain location. Night driving in blackout conditions.

Technical Assessment:

Warfighting Merit: Link to GPS so that the soldier knows where he is at all times. And route to take to get to location.

Current Projects:

None

Required Research:

- Ambient noise resistance systems
- Dialog systems

POC Jeff Jahnke

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Explosive Ordinance Disposal (EOD) disarming

Concept: Use intelligent knowledge based system to assist in bomb disposal training and disarmament for conventional ordinance.

Technical Assessment: Step by step procedure to disarm conventional ordnance. System can query a manual built into the database to step by step.

Warfighting Merit: Hands free to do work

Current Projects:

Required Research:

POC Jeff Jahnke

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Voice input to Standard Army Management Information System (STAMIS)

Concept: Interactive systems starting at the unit level through the division into corps - the Unit Level Logistics System (ULLS) system would provide diagnostic procedures indicating status as well as evacuation procedures through maintenance activities as well as repair part requisitioning to include voice query.

Technical Assessment:

Warfighting Merit: Enhanced battlefield logistics support operational status

Current Projects:

Required Research:

POC Karlo Aguilar

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: Voice print for supply distribution

Concept: Use NL to provide verification of individual receiving supplies.

Technical Assessment: Current shortcoming is the ability of individuals to duplicate voices or speech patterns of others; the different print produced by the same individual under stress or with an illness, etc.

Warfighting Merit: Would permit the rapid receipt of supplies.

Current Projects:

Required Research: To uniquely identify a person so that replication could be detected and identification made under different conditions.

POC Mary Lee Johnson

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Assistance)

Title: NL assistance to medical doctors

Concept: Use voice to assist the doctor either during an operation or in diagnosis of an illness. Use dictation to input to medical records.

Technical Assessment: Need expert knowledge that can be provided interactively with the doctor

Warfighting Merit: Aid in medical diagnosis of the soldier

Current Projects:

Required Research:

POC Miranda Moore

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Operations)

Title: Environmental warfighting suit

Concept: A combat uniform that would consist of sensors and environmental awareness data with voice query and recognition

Technical Assessment:

Warfighting Merit: Increased readiness

Current Projects:

Required Research:

POC Karlo Aguilar

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Operations)

Title: Nuclear, Biological and Chemical Detection

Concept: Develop a voice system to add to the field Chemical Detect alarm system that will tell the "user" what agent was detected. Not just have a beeper.

Technical Assessment: Will require M8 alarm to be able to detect specific agent. Currently done manually by the user. Want user to be able to have all inclusive system.

Warfighting Merit: Simplify soldiers task

Current Projects:

None

Required Research:

POC Jeff Jahnke

Spoken Human-Machine Dialogue Workshop

Panel: Combat Service Support
(Operations)

Title: Voice activated radio frequency identification tag

Concept: Using a tag that would provide voice response to spoken queries concerning container contents to include consignor, consignee

Technical Assessment: Interface with current and future transportation tracking networks

Warfighting Merit: Would provide Total Asset Visibility.

Current Projects:

Required Research:

POC Karlo Aguilar

DEPTH AND SIMULTANEOUS ATTACK

DEPTH AND SIMULTANEOUS ATTACK

M-16 MARKSMANSHIP

Concept:

Provide an automated spotter for marksmanship training. Immediate voice feedback. Error measurement. Diagnostic Analysis to shooter.

Technical Assessment:

FY 96 Existing technology

Warfighting Merit:

Reduces cost. Improves training. Improves training efficiency.

Required Research:

None.

SHMD in Support of Forward Observer

Concept:

Observer gives calls for fire and adjustments orally. Device provides feedback of observer's command and converts command to digital data for transmission. Device is capable of being reprogrammed for FO's native language. Highly restrictive grammar.

Technical Assessment:

FY 96

Warfighting Merit:

More effiicient operation for FO. Can continously track target. Decreased sensor to shooter timelines.

Required Research:

Dealing with pauses, starts, restarts and repeats.

DEPTH AND SIMULTANEOUS ATTACK

SHMD for the Conduct of Fire Trainer

Concept: The observer voices a correction for artillery rounds. The system reads back the correction and then applies it back to the fire trainer.

Technical Assessment:

FY96

Warfighting Merit:

Realistic training.

Cheaper, better, and faster.

Required Research:

None

SHMD Support of Helicopter Training

Concept:

Student flies aviation simulator. System provides student instant oratory feedback of errors and suggested corrections. System debriefs student after the mission and student can query computer orally for more details. Initially dialog from student will be similar to menu driven. Later phases will move toward free form text.

Technical Assessment:

Phase I - FY96

Phase II - TBD

Warfighting Merit:

Instant feedback and no inhibition to query machine numerous time vs querying instructor.

Required Research: Depends on speech freeform dialog requirements.

Digitized Overlays

Concept:

Commander or staff officer views the digitized terrain. Orally request specialized overlays be displayed on the screen. Screen provides zoom capability. Can also select particular features to be displayed or erased from the screen. Artificial intelligent agent will compute/ correlate between designated features on overlays. For example, an enemy unit on the SIGINT and OB overlay. Probability that more than one unit displayed on an overlay is only one unit vs several. (Voice interaction, touch screens, etc.)

Technical Assessment:

Phase I -FY96

Phase II - TBD

Warfighting Merit:

Better picture of battlefield, better targeting, cost reduction, better accuracy, timeliness, and information profiling.

Required Research:

Force XXI Network Vision Statement

Commanders from corps down must have nautural language dialog access to all pertinent data and information about friendly and enemy forces on the battlefield and this access is to be supported by the development of intelligent agents that will searach for find and presnet the required knowledge in natural language.

Research Issues:

Natural Language Processing

Common Sense Reasoning

Data Fusion

Tasks related to above:

Spatio-temporal reasoning

Deadline reasoning/planning

Contradiction-tolerance

Advice-taking

Context sensitivity, pragmatics

Coordination/negotiation

EARLY ENTRY, LETHALITY AND SURVIVABILITY

MISSION

-- Optimize

  - Lethality
  - Cdr's preparation of battlefield
  - Force mix
  - Organizational structure
  - Improve deployment
  - Capitalize on SOF and other services

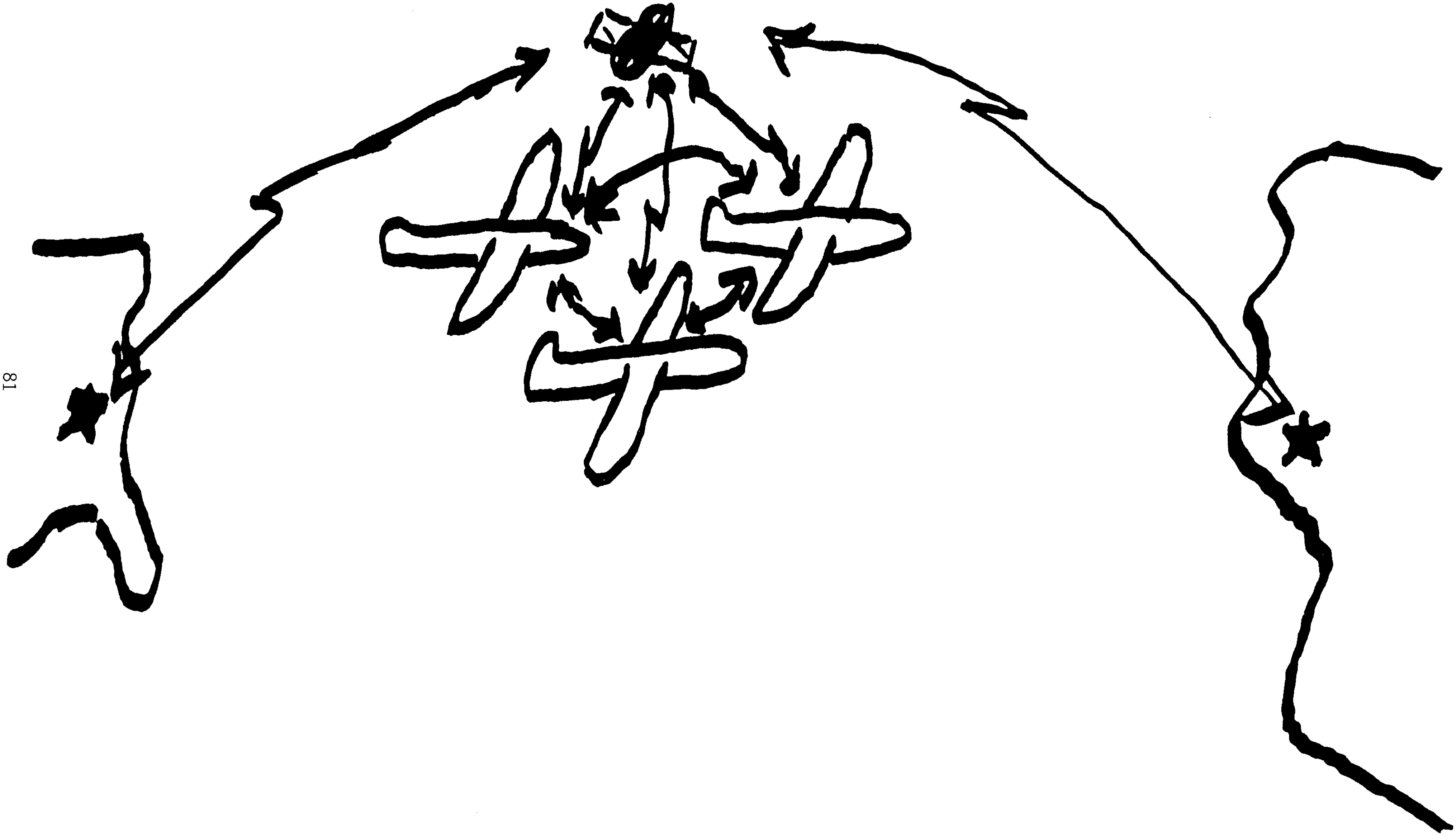
SHMD Operational
Uses to Support EELS

- Enroute Battle Command
- Situational Awareness
- Mission Planning
- Remote Warfare Ops.

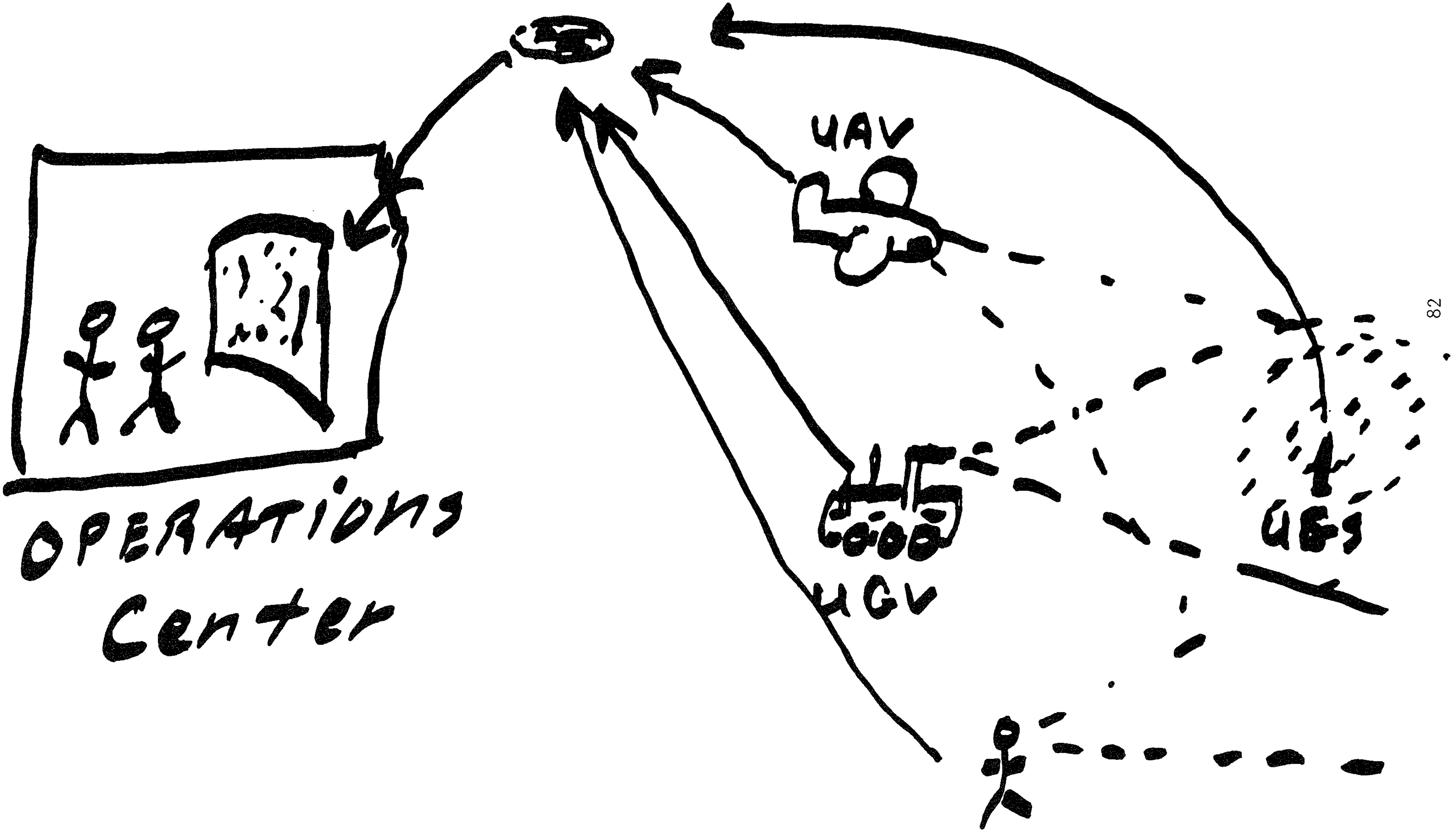
SHMD Assistance

- Operations
- Training Development
  - -- Task/Mission Analysis
  - -- Tng. Preparation

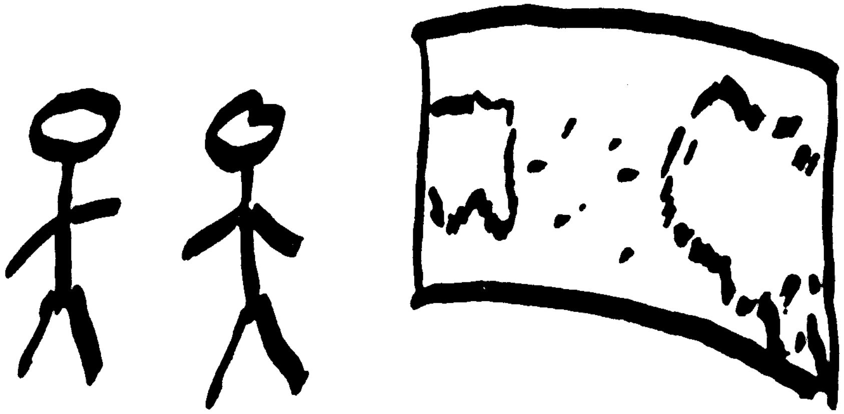
Enroute Battle Command



Situational Awareness



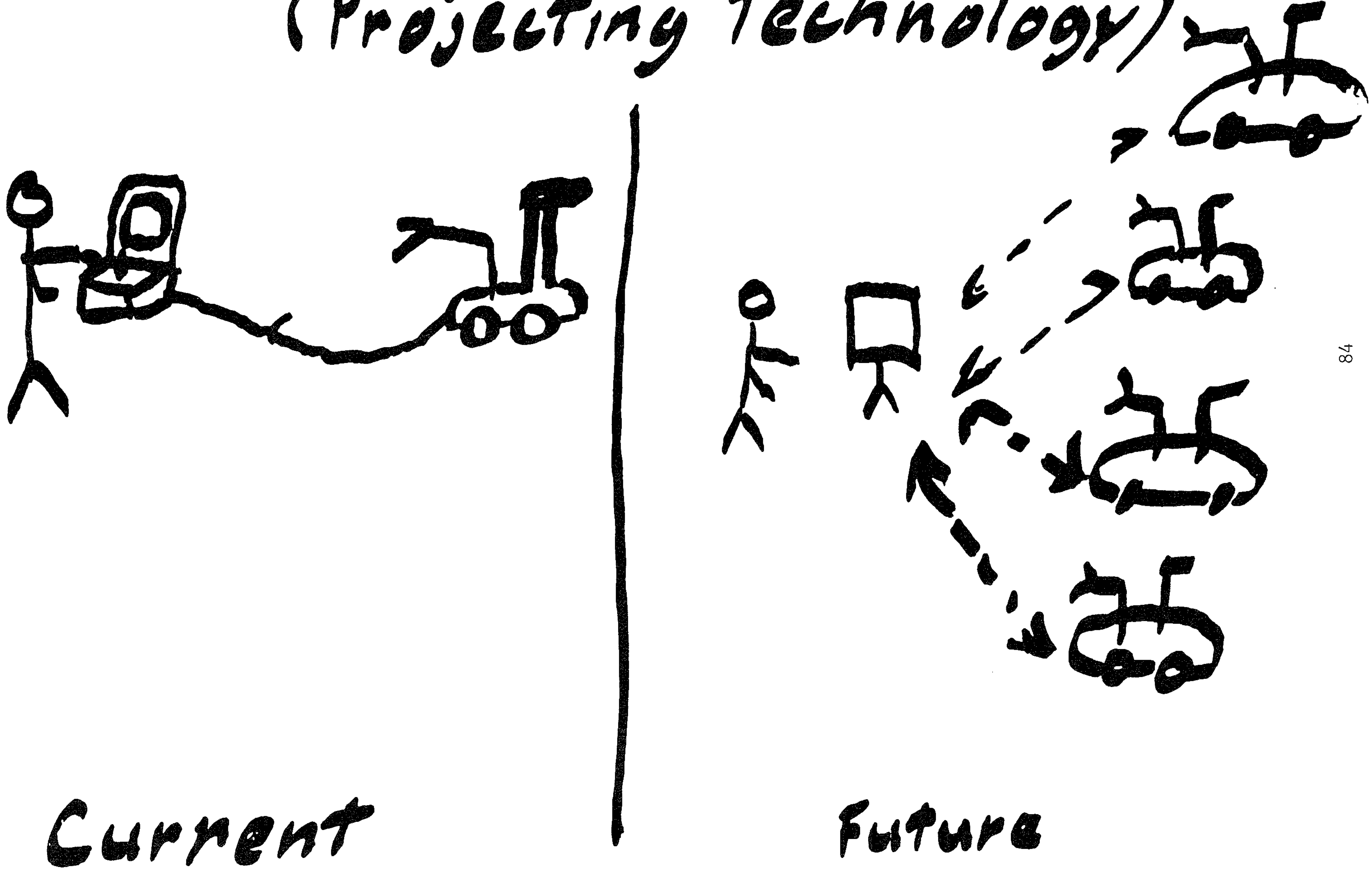
Mission Planning



- Deployment
  - resources
  - Assets
  - Host Nation

Remote Warfare

(Projecting Technology)



Spoken Human-Machine Dialogue Workshop

Concepts Worksheet

Panel: **<u>Early Entry Lethality and Survivability</u>**

Training Assistance Operations
(Circle One)

Title: Generalized multimedia machine code transducer

Concept: This system receives multimedia input from user and codes it for machine and network internal use. This system receives internal representations of messages to be delivered to the soldier and converts them to multimedia outputs for the soldier.

Technical Assessment: (Desired Capabiltities, Current Shortfalls)
This can be done in primitive form now. But huge improvements are needed.

Warfighting Merit: (Value added to Soldier)
Provides instanteous interaction with computer network for very fast control of action and very fast return of information to the network. Wide applicability to many types of fighting personnel--pilots, tank commanders, logistics personnel, and commanders.

Current Projects: Current networking within the army.

Required Research:

Multimedia transducers.
Multimedia dialogue theory.
Human factors work on multimedia systems.

LOUISIANA MANEUVERS

LOUISIANA MANEUVERS

Mitch Marcus
Computer Science Department
University of Pennsylvania

Report of the Louisiana Maneuvers Task Force Working Group

This group considered a range of applications for speech technology to enhance warfighting skills.

Three applications that were not discussed in other groups:

-The use of speech recognition and synthesis in simulated environments to enhance the realism of interaction in simulated environments. It should also be possible to enhance the realism of battlefield confusion with a realistic replication of the "din of battle" by synthesizing parallel radio traffic between other simulation agents. Voice interaction can also be used to greatly speed up the setup of simulated scenarios; CBS scenarios can take 2-6 months to develop currently

-Speech recognition can play a special role in language training, if speech recognizers and synthesizers for the necessary languages can be made available. The Army can take advantage of advanced systems that accurately recognize and correct accent. We will need systems that are sensitive to dialects; we need Haitian Creole as well as Parisian French.

-A voice interactive navigation assistant for land navigation in low-light/low-visibility conditions. Map reading on a ranger patrol can be lethal; we envision a combination of GPS and an expert system for route planning with voice input and output. The same kind of system with a map display will be useful for the Rotor Craft Pilot Associate, extending the current RCPA project.

All of these projects requires essentially the same core language research, including:

-An understanding of situated discourse with mixed initiative dialogue in constrained semantic domains.

-Language processing of sentence fragments from casual speech produced under stress.

-For the navigation assistant, speech recognition of whispered speech.

-A codification of the various Army jargons, by functional area.

-Generation of spoken natural language from computer input.

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

TRAINING

Title:
Use of speech recognition and synthesis in simulated environments

Concept:
Enhance realism of interaction in simulated environments. Enhance realism of battlefield confusion, realistic replication of the 'din of battle'

Technical Assessment:
Current shortfall--current interaction is limited to keyboard and mouse, desire more realistic interaction to reduce differentiation between man and machine speech. Speech generation from specific traffic to simulate the sense of chaos and confusion.

Warfighting Merit:
Better training makes the better soldier. Train as we fight -- more natural. Make simulation interaction more realistic

Current Projects:
Incorporate voice recognition in MODSAF

Required Research:
Fundamental: recognition of casual disfluent speech under stress in semantically constrained domains, must be dynamic. Simulate in radio and natural forms the communication traffic. Generation of natural language from the simulation. Codification of Army jargon by its several functional areas.

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

TRAINING

Title:
Voice interactive scenario generation and setup

Concept:
The setup of scenario is very time and labor intensive. For example CBS scenarios can take 2-6 months to develop.

Technical Assessment:
Short term goal to reduce time by one third and long term goal of two thirds reduction in time.

Warfighting Merit:
Make simulation more available and reduce time to react to short term threat. Gives more time for what if analysis.

Current Projects:

Required Research:
Scenario generation jargon; Grammar

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

TRAINING

Title:
Language Training

Concept:
To make available practical voice recognition \ multi-media recognition systems for language training

Technical Assessment:
Speech recognizers for a variety of languages. In long-term -- accent recognition and correction of phonemic features by mapping back toward articulation (correction on pronunciation). Must be sensitive to various dialects -- not just the generic\typical form e.g. Parisian french and Haitian Creole.

Warfighting Merit:
Critical training in intel gathering and liaison. Portable system fills void in speaking skills.

Current Projects:
61 person lab at USMA with voice interactive multi-media stations.

Required Research:
Accent recognition and automatic recognition of accent and dialects

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

ASSISTANCE APPLICATIONS

Title:
Maintenance assistant

Concept:
Hands free and eye free access to maintenance system to enhance field maintenance operations.

Technical Assessment:
Should be portable with spoken interface. Speech input and output combined with current trouble shooting. Advanced systems can include 3d rendering.

Warfighting Merit:
New systems deployable with little maintenance training. Would give users in field immediate maintenance capability.

Current Projects:
RTI project

Required Research:
Same as above

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

ASSISTANCE APPLICATIONS

Title:
Voice interactive navigation assistant

Concept:
Voice interactive land navigation in low-light\low-visibility conditions.

Technical Assessment\Warfighting Merit:
Map reading on a ranger patrol can be lethal -- combination of GPS and an expert system for root planning with voice in and output will allow for safer more reliable navigation under low light conditions and other conditions of low visibility. The same kind of system with map display will be useful for the rotor craft pilot associate. RTPA must be able to integrate situational awareness (friendly and enemy)

Current Projects:
Extension of technology in current RTPA project.

Required Research:
Navigational planning; dynamic root planning. Situated discourse, mixed initiative dialogue, sentence fragments, casual speech, whispered speech.

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

ASSISTANCE APPLICATIONS

Title:
Voice interactive version of existing Trauma

Concept:
TRAMAID expert system could be enhanced by the addition of speech input\output, allows hands free eyes free

Technical Assessment:
Use of current system requires additional personnel for keyboard input

Warfighting Merit:
More efficient use of expert system that will save lives

Current Projects:

Required Research:
Same as above

LOUISIANA MANEUVERS TASK FORCE WORKING GROUP

OPERATIONS

Title:
Enhancement of Battlefield Visualization systems

Concept:
Make current designs more accessible to voice interaction technology

Technical Assessment:
Minimize\eliminate use of keyboard and mouse to enable a more portable system. Desired system should be able to clarify what is asked for as needed. For example, want a multi-media expert which will show unit status while highlighting recent changes in speech.

Warfighting Merit:
More natural interface, better access to data.

Current Projects:
Pheonix

Required Research:

ATTACHMENTS

Attachment A

April 18, 1995

Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

Dear Sir/Maam:

You are invited to attend a workshop that will focus on spoken human-machine dialogue (SHMD) technology and systems. University research in natural-language processing is reaching a level of maturity where it is now appropriate to examine the transfer and integration of natural-language systems into requirements and prototypes that support the realization of Army Force XXI capabilities. There also is a need to identify and focus future basic research to ensure that the full potential of natural-language processing is realized for both military and civilian applications. The workshop will attempt to identify and address the relevant issues.

Specific objectives for the workshop include the following (the Agenda is presented in Attachment A):

- Introduce workshop participants to SHMD
- Review the status of SHMD technology
- Develop Operational Capability Requirements to support TRADOC BattleLabs in Army Training, Assistance and Operational applications of SHMD
- Identify basic research needs and opportunities based on futuristic concepts

This workshop is being sponsored by the Army Research Office with participation by TRADOC. The registration fee is $110 (see Attachment B for details) and attendance is by invitation only. The location and dates of the workshop are:

Sheraton Imperial Inn, Research Triangle Park, NC

May 30, May 31 and June 1, 1995

Please direct any questions to the following:

Dave Hislop:	(919) 541-4255, hislop@aro-emh1.army.mil
Brad Shaffer:	(804) 727-4481, shafferb@monroe-emh1.army.mil

Your contribution will be essential to the success of this workshop. We look forward to seeing you there.

Sincerely yours,

David W. Hislop

Attachment B

ADMINISTRATIVE INSTRUCTIONS

Spoken Human-Machine Dialogue Workshop

Workshop POCs:

Army Research Office:
Dr. Dave Hislop
Tel #: (919) 549-4255
E-mail: hislop@aro-emh1.army.mil

TRADOC:
Major Brad Shaffer
Tel #: (804) 727-4481
E-mail: shafferb@monroe-emh1.army.mil

Workshop Location:
Sheraton Imperial Hotel
P.O. Box 13099
Research Triangle Park, NC 27709
Phone: (919) 941-5050
FAX: (919) 941-5156

Hotel Point of Contact: Ms. Kara Cuscaden (National Sales Manager)

Workshop Dates/Time: 301300 May 95 to 011500 June 95

Workshop Attire: Class B uniform/business attire. Business attire is suggested for all participants at the banquet on 30 May.

Hotel Room:

A block of forty rooms have been reserved, under the name Spoken Human-Machine Dialogue Workshop, at the Sheraton Imperial Hotel at Government per diem rates. These rooms will be available on a first come basis until May 5, 1995; after which the Hotel will use normal reservation procedures and charge normal prices for rooms that might be available. The Sheraton Imperial is located 2 miles north-west of the RDU Airport, (Exit Page Rd. off Interstate 40).

Reservations:

Participants are requested to make individual room reservations directly with the Hotel. When making reservations, ask for the block of rooms reserved for the ARO-TRADOC Spoken Human-Machine Dialogue Workshop. Reservations must be made before May 5, 1995 to receive the Government per diem rate.

Transportation:

Workshop participants are responsible for individual transportation. The Raleigh-Durham International Airport (RDU) serves the Research Triangle Park and surrounding region. The Sheraton Imperial Hotel provides shuttle transportation vans between the Hotel and the airport. Taxi is also available for the short five minute drive.

Registration Fee:

A Workshop registration fee is being charged to each participant. This registration fee pays for two lunches, the banquet, refreshments during the Workshop, and other miscellaneous expenses necessary for a successful Workshop. This registration fee is to be paid to the Sheraton Imperial Hotel and may be added to the hotel bill at check-in.

Registration Form:

To assist in the planning for the Workshop, each participant is asked to fill out and FAX the registration form provided on the following page by May 15, 1995 to:

Ms. Ingrid Agolia
Tel #: (919) 541-6297
FAX #: (919) 541-6965
E-mail: iba@es.rti.org

REGISTRATION FORM

Spoken Language Dialogue Workshop

Name of Participant:

Organization:

Expectations:

Each participant will be assigned to one of seven Working Groups during breakout sessions to examine and develop issues and applications of spoken language dialogue. Each Working Group will be chaired by a representative for the TRADOC BattleLabs and co-chaired by a representative of the Army's scientific community. Please indicate below your preferences (1-7) for assignment to the Working Groups. Your response will be used for planning and making Working Group assignments; please provide this information by May 15, 1995 to the individual noted below.

Order of Working Groups Preference (1-6)

---- Battle Command

---- Mounted Warfighting Battlespace

---- Combat Service Support

---- Depth and Simultaneous Attack

---- Early Entry Lethality and Survivability

---- Louisiana Maneuvers Task Force

Please provide the above information by May 15, 1995 to:

Ms. Ingrid Agolia
Tel #: (919) 541-6297
FAX #: (919) 541-6965
E-mail: iba@es.rti.org

Attachment C

Spoken Human-Machine Dialogue Workshop

Attendees

Karlo A. Aguilar
U.S. Army CASCOM
ATCL-MT
Ft. Lee, VA 23801-600
(804) 734-2099
(804) 734-1174 (fax)
aguilark@lee-dns1.army.mil

Alan W. Biermann
Duke University
Department of Computer Science
P.O. Box 90129
Durham, NC 27708
(919) 660-6500
(919) 660-6519 (fax)
awb@cs.duke.edu

Dr. Jim Brown
Research Triangle Institute
3020 Cornwallis Rd.
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6975
(919) 541-6965 (fax)
jnb@es.rti.org

Tanya N. Bui
U.S. Army CASCOM
ATCL-B
Ft. Lee, VA 23801
(804) 530-1491
(804) 530-2880 (fax)
buit@lee-dns1.army.mil

Howard Burnette
U.S. Army CASCOM
Attn: ATCL-MT
Ft. Lee, VA 23801-6000
DSN 687-0586
(804) 734-0586
(804) 734-1174 (fax)
burnetth@lee-dns1.army.mil

Chuck Campbell
U.S. Army Mounted Battlespace BattleLab
Cdr, USAARMC, Attn: ATZK-MW
Ft. Knox, KY 40121
(502) 624-1963
(502 624-1932 (fax)
campbelc@knox.army.mil

Edward J. Carroll
U.S. Army ARDEC
AMSTA-AR-FSF-R, Bldg. 95N
Picatinny Arsenal, NJ 07806-5000
(201) 724-7280
(201) 724-7279 (fax)
ecarrol@pica.army.mil

David L. Carter
Early Entry Lethality, Survivability BattleLab
Commander TRADOC
Attn: ATCD-L
Ft. Monroe, VA 23651-5000
(804) 727-4203
(804) 728-5861 (fax)
carterd1@monroe-emh9.army.mil

Jagdish Chandra
Director, Mathematical and Computer Sciences
U.S. Army Research Office
RTP, NC 27709
(919) 549-4254
(919) 549-4310 (fax)
chandra@aro-emh1.army.mil

Malvin J. Chernow
Director of Contracting
USA Intel Ctr./BCBL-H

P.O. Box 748
Attn: ATZS-DKO-I
Ft. Huachuca, AZ 85613-0748
(602) or (520) 538-0422
(602) or (520) 538-0415 (fax) 533-1600 (fax)
chernow1%hua1@huachuca-emh11.army.mil

Hugh Dempsey
Louisiana Maneuvers Task Force
Attn: DACS-LMI
Ft. Monroe, VA 23651
(804) 728-5822
(804) 728-5810 (fax)
dempseyh@monroe-emh11.army.mil

J. L. Enriquez
Department of the Army
USAADASCH
Attn: ATSA-ADL
Ft. Bliss, TX 79916-3802
(915) 568-7613
(915) 568-2530 (fax)
enriqueL@bliss-emh1.army.mil

Jerry Evans
U.S. Army Missile Command
Missile Research, Development, and Engineering
Center
AMSMI-RD-AC
Redstone Arsenal, AL 35898-5242
(205) 876-2357
(205) 876-0640 (fax)
evans-rd-ac@redstone-emh2.army.mil

Michael W. Freeman
BCBL
Attn: ATZL-CDB
Ft. Leavenworth, KS 66027
(913) 684-2357
(913) 684-2350 (fax)
freemanm@leav-emh.army.mil

CPT Mary Ann Gilgallon
CSS Battle Lab, CASCOM
Ft. Lee, VA 23801
(804) 734-2285
(804) 734-2280 (fax)
gilgallm@lee.dnsl.army.mil

Ed Greisch
ACALA-AC-MAEE
Rock Island Arsenal, IL 61299
DSN 793-0018
maeweg@ria-emh1.army.mil

Curry Guinn
Research Triangle Institute
3040 Cornwallis Rd.
Research Triangle Park, NC 27709
(919) 541-8707
(919) 541-6965 (fax)
cig@es.rti.org

Carlton Harris
HQ TRADOC, Battle Lab Integration, Technology
and Concepts Dir.
Attn: ATCD-BP
Ft. Monroe, VA 23651
(804) 727-4136
(804) 727-3445 (fax)
harrisc@mon1-emh1.army.mil

Robert F. Helms
Research Triangle Institute
3040 Cornwallis Road
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-7166
(919) 541-6965 (fax)
rfh@es.rti.org

Ray Higgins
Aviation Applied Technology
Directorate/Rotorcraft Pilots Assoc.
Bldg. 401
Attn: AMSAT-R-TDRP (R. Higgins)

(703) 883-6435 (fax)
macmillan@ai.mitre.org

Mitch Marcus
University of Pennsylvania
2000 S. 33rd St.
Philadelphia, PA 19104
(215) 898-2538
(215) 898-0587 (fax)
mitch@cis.upenn.edu

Wesley A. Milks
U.S. Army, Simulation, Training &
Instrumentation Command (STRICOM)
Attn: AMSTI-EE
12350 Research Parkway
Orlando, FL 32826-3276
(407) 381-8789
(407) 384-2338 (fax)
milksw@stricom.army.mil

Walter Miller
U.S. Army Aviation Center
ATZO-CD
Ft. Rucker, AL 36362-5000
(334) 255-2346/9589
(334) 255-1214 (fax)
miller3@ruc1.army.mil

R. Jorge Montoya
Research Triangle Institute
3040 Cornwallis Road
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6807
(919) 541-6965 (fax)
rjm@es.rti.org

Miranda Moore
U.S. Army Logistics Evaluation Agency
LOEA-PL
New Cumberland, PA 17070-5007
(717) 770-7600
(717) 770-6702 (fax)
moore@pentagon-hqdadss.army.mil

Daniel B. Nissman
Research Triangle Institute
3040 Cornwallis Road
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-5801
(919) 541-6965 (fax)
dbn@es.rti.org

Don Perlis
University of Maryland, College Park
Computer Science Dept., A.V. Williams Bldg.
College Park, MD 20742
(301) 405-2865, (301) 405-6707 (fax)
perlis@cs.umd.edu

MAJ Brad Shaffer
Battle Labs Integration, Technology and
Concepts Directorate
HQ TRADOC
Attn: ATCD-B (Maj Shaffer)
Ft. Monroe, VA 23651-5000
(804) 727-4481
(804) 727-2947 (fax)
shafferb@monroe-emh6.army.mil

Dana Smith
NAWC TSD
12350 Research Parkway
Orlando, FL 32826-3224
(407) 380-4607
dana@ntsc-rd.navy.mil

MAJ Donald Starck
U.S. Army
ATSF-CBL (DSA Battlelab)
Ft. Sill, OK 73503-5600
(405) 442-5647
(405) 442-5028 (fax)
starck@sill-battlelab.army.mil

Bill Toth
HQ CECOM

Ft. Eustis, VA 23604-5577
(804) 878-2371
(804) 878-3108 (fax)
rhiggins@eustis-aatds1.army.mil

David W. Hislop
U.S. Army Research Office
Attn: AMXRO-MCS (Dr. David W. Hislop)
P.O. Box 12211
Research Triangle Park, NC 27709
(919) 549-4255
(919) 549-4288/4310 (fax)
hislop@aro-emh1.army.mil

Melissa Holland
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333-5600
(703) 274-5569
(703) 274-3573 (fax)
holland@alexandria-emh2.army.mil

Deanna Jenkins
Louisiana Maneuvers Task Force
Attn: DACS-LM, Bldg. 83
Ft. Monroe, VA 23651
(804) 728-5317
(804) 728-5826 (fax)
jenkinsd@monroe-emh11.army.mil

Mary Lee Johnson
Data Systems Research and
Development/Lockheed Martin
1099 Commerce Parks
M/S 7619, Rm. W30
Oak Ridge, TN 37830
(615) 576-8573
(615) 574-7624 (fax)
mlj@ornl.gov

Aravind K. Joshi
University of Pennsylvania
Department of Computer and Information
Science
Room 555, Moore School
Philadelphia, PA 19104
(215) 898-8540
(215) 898-0587 (fax)
joshi@linc.cis.upenn.edu

LTC Stephen A. LaRocca
Department of Foreign Languages
U.S. Military Academy
West Point, NY 10996
(914) 938-5286
(914) 938-3585 (fax)
gs0416@usma3.usma.edu

CPT Kelly Lauritzen
Battle Command Battle Lab
Attn: ATZL-CDB
Ft. Leavenworth, KS 66027
(913) 684-2362
(913) 684-2350 (fax)
lauritzk@leav-bcbl.army.mil

John Lavery
Army Research Office
Mathematical and Computer Sciences
Division
AMXRO-MCS
P.O. Box 12211
Research Triangle Park, NC 27709-2211
(919) 549-4253
(919) 549-4310 (fax)
lavery@aro-emh1.army.mil

Ming C. Lin
Army Research Office
Math and Computer Science Division
Research Triangle Park, NC 27709
(919) 549-4256
lin@cs.unc.edu

T. Richard MacMillan
The MITRE Corporation
M/S Z464
7525 Colshire Drive
McLean, VA 22075
(703) 883-7796

AMSEL-RD-C2-BB-CC
Bldg. 2525
Ft. Monmouth, NJ
(908) 427-3819
(908) 427-4087 (fax)

Clifford Weinstein
MIT Lincoln Laboratory
244 Wood Street
Lexington, MA 02173-9108
(617) 981-7241
(617) 981-0186 (fax)
cjw@sst.ll.mit.edu

James B. Widby
U.S. Army BCBL (G)
Attn: ATZH-BLT, Bldg. 71600
Ft. Gordon, GA 30905-5299
(706) 791-8344
(706) 791-8346 (fax)
widbyj@bcblg.gordon.army.mil

David Williamson
USAF, WL/FIGP-2
2210 Eighth St., Ste 1
WPAFB, OH 45433-7511
(513) 255-6696
(513) 476-4547 (fax)
williadt@wl.wpafb.af.mil

Attachment D

Agenda

Spoken Human-Machine Dialogue Workshop

Tuesday, May 30, 1995

Time	Activity	Responsibility
1300-1315	Welcome/Introduction	J. Chandra
	Technology Status/Overview	
1315-1415	Human-Machine Interactions in 2020	C. Weinstein
1415-1515	Natural Language Processing Overview	M. Markus
1515-1530	Break	
1530-1615	Spoken Language Dialogue	A. W. Biermann
	Demonstration	
1615-1745	Spoken Human-Machine Dialogue Maintenance Trainer and Intelligent Assistant	J. N. Brown
	Open Time/Social Hour/Dinner	
1745-1830	Open Time	
1830-1900	No Host Social Hour	
1900-1945	Dinner	
1945-2015	Dinner Speaker	T. Edwards

Wednesday, May 31, 1995

0800-0850	Examples of Army Natural Language Applications	CPT K. Lauritzen
0900-1100	Working Groups Examination: *Training Applications*	Dir, BattleLabs
1100-1130	Break	
1130-1230	Working Groups Examinations: *Assistance Applications*	Dir, BattleLabs
1230-1330	Lunch	
1330-1430	Working Groups Examinations: *Assistance Applications* (Cont.)	Dir, BattleLabs
1430-1500	Break	
1500-1700	Working Groups Examinations: *Operational Applications*	Dir, BattleLabs
1700-1730	Summary of Day's Activities	J. Chandra

Time	Activity	Responsibility
	Thursday, June 1, 1995	
0800-0915	Working Group Report Out: *Training Applications*	Dir, BattleLabs
0915-0930	Break	
0930-1045	Working groups Report Out: *Assistance Applications*	Dir, BattleLabs
1045-1200	Working Group Report Out: *Operational Applications*	Dir, BattleLabs
1200-1300	Lunch	
1300-1430	Presentation of Specific Projects	Dir, BattleLabs
1430-1500	Workshop Closing Remarks	J. Chandra
1500	Workshop Conclusion	J. Chandra