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14. ABSTRACT

The purpose of this grant was to investigate the state-of-the-art of information science (IS) research in the territory of the Asian Office of Aerospace Research and Development (AOARD), analyze its relevance to the Air Force Office of Scientific Research (AFOSR), and recommend appropriate activities for AOARD to consider funding under its basic research program. This was accomplished through several field trips to countries in the AOARD territory (which covers Asia and Australasia), through studying the information sciences literature for the relevant countries, through meetings with all of the AFOSR and AOARD Program Managers covering IS topics, and through attendance at several conferences and workshops.

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Summary of Activities

The purpose of this grant was to investigate the state-of-the-art of information science (IS) research in the territory of the Asian Office of Aerospace Research and Development (AOARD), analyze its relevance to the Air Force Office of Scientific Research (AFOSR), and recommend appropriate activities for AOARD to consider funding under its basic research program. This was accomplished through several field trips to countries in the AOARD territory (which covers Asia and Australasia), through studying the information sciences literature for the relevant countries, through meetings with all of the AFOSR and AOARD Program Managers covering IS topics, and through attendance at several conferences and workshops including the AFOSR Spring Review.

Japan and Australia, the dominant countries in terms of breadth and depth of IT research in the official AOARD territory, received the most coverage during the term of this grant. In both cases the PI spent a week in-country visiting with members of key research universities and research institutes, and then providing a formal report to AOARD as well as informal advice to AOARD IS Project Managers (Hiroshi Motoda and David Atkinson). In both cases this led to new IS grants in FY2009 and in the case of Australia to a major expansion of granting activities in that country. The PI also conducted a short (2-day) investigation of IS work in Singapore which led to a proposal for collaboration in the areas of cybersecurity between an existing AOARD grantee and colleagues in the US.

In the case of Japan, the trip report, including follow-up recommendation, is included below; for Australia, the PI acted as co-author of an extensive report authored by David Atkinson that is available through AOARD.

Although The People's Republic of China (PRC) is not yet an official part of the AOARD territory in terms of funding basic research, the PI, in consultation with AOARD staff, decided that the long-term potential for becoming a critical player in the basic IS research community was so high, that he took advantage of an opportunity to begin exploring the state of IS research there. The opportunity was an invitation to participate in the non-governmental "People-to-People Ambassadors" program (founded by Dwight Eisenhower) which sends international teams of domain specialists to explore technical topics in developing countries. This particular group was on the topic of "Artificial Intelligence and Robotics in China" and was led by Prof. Katia Sycara of Carnegie-Mellon University. The week-long trip covered 4 of the 6 "key universities" in IS in the PRC as well as several lesser sites. This trip, along with an extensive analysis of Chinese contributions to the major international AI conference, IJCAI-09, held in Pasadena in mid-July 2009, led to a report on the topic of Information Sciences in China that was written under a following AOARD grant to the PI (and is included in the final report of that grant, FA2386-09-1-4120). Appendix I of this report is the factual trip report of the China visit, authored by Prof. Sycara and co-authored by the PI and several others.

As described above, one of the goals of this grant was to understand the overall strategy for IS research funding by AFOSR in order to advise AOARD on how best to fit within the current strategy and help expand the scope of IS research for AFOSR in the future. After dozens of discussions with AFOSR and AOARD Program Managers along with Dr. Brendan Godfrey, Director of AFOSR, and attendance at the comprehensive AFOSR Spring Review, the PI delivered an analysis of the current program and recommendations for future IS research activities to both Dr. Godfrey and Dr. Ken Goretta, Director of AOARD. That report is summarized below.

Japan Report and Recommendations

The visit covered several current grantees and potential future grantees in Tokyo, the JAXA aeronautics laboratory in Tokyo, and two industrial research laboratories (NTT and ATR) near Kyoto. I will summarize each of the technical meetings and provide recommendations relative to those activities. In addition, I will provide some summary recommendations at the end of this report.

Professor Yuko Ohsawa, University of Tokyo: Prof. Ohsawa talked to me about his work in "chance discovery," which is finding hidden patterns among seemingly unrelated events organized in the form of networks. While such work in machine learning is not new, the way Ohsawa's work integrates automated discovery with human interaction is novel and potentially valuable. Professor Ohsawa provided me with three recent

publications that describe his method, including one that applies the methodology to the application of innovating by combining information from seemingly unrelated patent disclosures.

I found the work interesting, of high quality, and within the scope of the current AFOSR BAA. However, I think AOARD should work with Prof. Ohsawa to find at least one test domain that is at least broadly relevant to potential AF problems. The work is approaching the maturity level where it should be possible to use the algorithms productively on such problems, and doing so will illustrate why basic work on network analysis is worthy of support.

Professor Kazumi Saito, University of Shizuoka: Professor Saito presented his work on "knowledge discovery from social networks" along with four recent publications. This research is being done jointly with Hiroshi Motoda of the University of Osaka and AOARD. Prof. Saito and colleagues have done a very nice job of analyzing social networks and providing mechanisms for solving such problems as highlighting information flow, discovering the most influential nodes, and determining how to block the propagation of undesirable information (such as blocking viruses induced into networks). They have compared their methods to a wide variety of prior algorithms and provided a formal mathematical underpinning to most of their work.

I think the work is excellent and potentially important to a wide variety of AF and other US government problems (e.g. DISA and DHS should be interested in the methods for analyzing and stopping cyber-attacks). Saito and colleagues have thought about applications (he mentioned some medical ones to me), but I strongly suggest that AOARD now provide the guidance to apply the work to realistic test data from AF-related problems. This research is clearly ready for exposure to the broader AFRL community.

Professor Masashi Sugiyama, Tokyo Institute of Technology: Prof. Sugiyama is a up-and-coming potential star at TIT suggested by Hiroshi as a potential grantee. His work is in supervised machine learning (learning where there is initial calibration from a set of training data) where the actual domain is different in some significant manner from the training set--in other words where extrapolation from a training set is common as opposed to pure interpolation. Prof. Sugiyama has thought about applications in robot control and speech understanding and gave compelling arguments for the relevance of his research to these problems.

I found Prof. Sugiyama to be very smart, skilled at clearly describing his research, and potentially adroit at seamlessly moving between basic and applied work as research progress dictated. He wants to focus on basic work, but to carry forward his methodology to broadly usable algorithms and advise others on their application to challenging real world problems. I think he would be a strong addition to the group of AOARD grantees.

Professor Kinji Mori, Tokyo Institute of Technology: Prof. Mori is a very senior computer scientist who pretty much invented "autonomous decentralized systems" as an architecture for computers, networks, social systems. An international community in ADS has existed for about twenty years, holding biannual symposia and publishing a journal on the topic. Such currently popular methods as autonomic computing sprung at least partially from this work.

AOARD research support of Prof. Mori doesn't make much sense given his existing very large base of industrial and governmental funding, but he is willing (largely because he and Hiroshi are both part of the "Hitachi mafia") to be a friend to AOARD. I think the best way to utilize him would be to consider having a workshop on innovative computing and network architectures for AFOSR and AFRL personnel with Prof. Mori as a plenary speaker and co-organizer.

NTT Communications Science Laboratory, Kyoto: Hiroshi Motoda and I took a one-day trip to Kyoto to examine some of the research at NTT and ATR. They were both very kind to spend a few hours with us describing their work. NTT Communications Science Laboratory is composed of about 120 scientists split among two locations (about 60 at each). The Kyoto lab is surprising spacious, particularly among Japanese laboratories, for only 60 scientists and is very well equipped. Their work focuses on multimedia, human-machine interaction (including natural language and speech understanding), and cognitive neuroscience.

We saw two demonstrations at NTT. The first, by Takeshi Yamada of their Emergent

Learning Group, was of a variety of novel display methods utilizing color, 3D effects,

and other grouping techniques to allow human mining of very large data bases. The

second, by Hideki Isozaki of their Knowledge Processing Research Group, covered

recent progress in natural language understanding.

I found the display demonstration very interesting and potentially of significant interest to

AOARD. While none of the individual presentation methods were unique, the

integration was done well and it definitely made visualization of a large-scale database,

presented over a large geographical setting, quite facile. I think it is worth an early

follow-up visit by David Atkinson and a discussion on potential exposure of the

technology to AFRL personnel. The NL demonstration, on the other hand, I found

frankly boring. Progress in NL worldwide seems to proceed at a glacial pace. I saw very

little improvement over work from ten or even twenty years ago at other Japanese NL

projects at ETL, for example. It may just be the nature of the beast, but I don't think it is

of particular interest to AOARD

Advanced Telecommunications Research Institute (ATR), Kyoto: ATR is a well-known

communications and information technology laboratory, supported by 121 member

companies and composed of 256 research scientists in knowledge systems, robotics,

computational neurosciences, language processing, and optics. We viewed two projects.

The first was in integration of 3D vision, sound, and touch to allow human interaction

with virtual copies of complex artifacts. The second was a medical knowledge acquisition and problem-solving project.

The first project was one of the best multi-sensory demonstrations I have ever seen. The group led by Hiroshi Ando had laser scanned an ancient copper mirror that had extensive carvings and texture on the non-mirrored side. Using off the shelf hardware for 3D viewing, sound generation, and haptic feedback, they created a total experience that seemed identical to touching, seeing, and hearing (as you tapped the mirror) the actual object. I could even feel the rust on the object. They added to that software to change the mirror to a simulated original condition, stripping off the rust and returning the mirrored surface to original form. I could turn the object, with appropriate force-feedback to view either side. This work clearly had a host of potential applications in educational, medical, design, and other domains where multi-sensory feedback is useful. I could imagine many Air Force applications for virtual cockpits, UAV control, etc. I got a copy of the detailed paper describing the work. I strongly recommend that AOARD follow up with Dr. Ando.

The second project, presented by Akinori Abe, was a medical expert system for advising on common nursing actions. There was some interesting knowledge acquisition work using video studies of actual human behavior and some attempt to find errors by comparison to stored scenarios, but overall it was fairly routine work by current standards. Given the current prohibition on AFOSR work in medical domains, I don't recommend follow-up.

JAXA: my final visit was to JAXA's Aerospace Research and Development Group in the Tokyo suburbs, accompanied by Takao Miyazaki. JAXA was very hospitable with five senior engineering managers attending. I received three briefings: from the civil transport group on the design of a new environmentally-friendly regional jet, helicopter group on noise reduction research, and from the supercomputing group on the design of their new 120 teraflop machine that will be coming online in the next few months.

As someone who interacted extensively with NASDA in the past, particularly in space AI and robotics, I was very pleased to feel welcome at the JAXA aviation laboratory. While most of the work is considerably more applied than the basic work supported by AOARD and AFOSR, I recommend AOARD take advantage of their willing to meet by helping facilitate the appropriate AFRL visits when mutually convenient. There are almost surely some commercially sensitive areas in aircraft design specifics, but the JAXA people seemed quite willing to share their research in helicopter noise reduction, for example, which is clearly a topic of interest to the US military.

Overall, I was very impressed by the AOARD staff and by those existing grantees I visited. It is very clear that Hiroshi Motoda is both well-known and respected in many segments of the Japanese IT research community; this is an enormous asset to AOARD. I believe the next steps involve adding more focus and planning to the IT effort. Network analysis and social networking are certainly one theme of current work, but I don't believe there is yet a five or ten year plan that both explains why the work is important to AFOSR (and then AFRL and the AF overall) and provides common test domains for

measuring the success of the work. I believe the best basic work that is sponsored by mission organizations has metrics both of the standard academic type (i.e. publication in the best journals and at the best conferences) and of technology transfer. The two current AOARD funded projects I examined were both ready for a technology transfer analysis. That is one of the benefits IT research has over many other types—the pathway from very basic work to fielded applications can be very short (years or even less), and, taking the technology transfer pathway seriously actually benefits the conduct of the basic work.

Analysis and Recommendations on Overall AFOSR Basic IS Research

There are three topics I am going to cover below: what makes IT research different from most of the 6.1 work covered by AFOSR, how to ease the technology insertion process into USAF missions without compromising basic research, and what topics I believe should form the core of a well-balanced IT research program for AFOSR. For the final topic, I'll provide my very brief and preliminary assessment of the current AFOSR program in each area and indicate what other US government organizations are currently leaders and/or potential partners.

The Nature of IT R&D

For most fields of science, there are long and reasonably well-defined transition periods between basic research, applied research, and actual end applications. For example, it may be decades between basic advances in polymer sciences and a new material for an airframe or between fundamental work in propulsion chemistry and a new rocket engine. It is normally easy to look at a proposal and classify the work as 6.1, 6.2 or 6.3 in those fields. But Information Technology is different. This is mainly true because most IT work, no matter how basic, centers on creation of human-developed artifacts (i.e. algorithms or heuristics in the form of software codes) as opposed to discovery and theory building to explain those discoveries (as in physics and chemistry).

Because IT research (at least most forms of it, some work in theory of computation and in cognitive sciences—which has a fuzzy boundary with IT research—is much closer to physics and chemistry research) entails developing and testing software, often that software can prove to be directly useful in the problem domain in which it is tested. Let me provide three examples of that from my own experience:

- In 1987, Dr. Steven Minton and colleagues at NASA Ames Research Center, along with collaborators at Johns Hopkins University, began a basic research investigation in constraint-satisfaction techniques involving simulated annealing and various hill-climbing methods. They chose as a test domain the scheduling of science experiments for the Hubble Space Telescope (Johns Hopkins runs the Space Telescope Science Institute so they had easy access to enormous data sets). Within two years, they had developed a new methodology that was published in the two most prestigious venues (The Journal of Artificial Intelligence and the Proceedings of the International Joint Conference on Artificial Intelligence). In addition, the software they developed was such a dramatic improvement over the then-in-use scheduling system for Hubble that it within 3 months of publication of the work it had been adapted for production use at the Institute.

- In 1988, Peter Cheeseman and colleagues, also at NASA Ames, started work on Bayesian approaches to machine learning. Machine learning covers a spectrum of work from knowledge-rich methods (where an underlying domain theory is used to guide learning) and knowledge-weak methods (where patterns in the data you

are attempting to classify "speak for themselves" based on statistical analysis). Cheeseman's work was far to the knowledge-weak side of that spectrum. The team developed a new classification methodology they called "AutoClass" which automatically broke any data set into statistically significant categories without any prior knowledge of what the data represented. They used as a test data set, a very large database of observations from NASA's Infrared Astronomical Satellite. As in the above case, the work was published in the premier journal and venue for artificial intelligence research. It also produced as an immediate side effect a new classification (into galaxies, stars, and nebulae) of the Infrared Satellite data that was immediately adopted by the astronomers and published as the official catalog of infrared objects.

I picked the above two examples to help illustrate how working on real data sets and taking advantage of the opportunity to help the missions of the funding Agency directly did no harm to the basic research nature of the work. Far from that, a strong claim could be made that by working on challenging real world problems, better basic work was done. Empirically part of the proof of that statement comes from the fact that the two projects I've just described won the last two "Legacy Paper" awards (for 2007 and 2008) given by the main AI professional society, the Association for the Advanced of Artificial Intelligence (AAAI). This is the award given for work at least 15 years after initial publication that had the most affect on research in AI over that period of time.

- My final example is a bit different because it illustrates how what at the time was a small component of a basic research effort in IT led to direct value to a very broad academic and commercial community. It comes from my own thesis work in the period from 1974 to 1979 at Stanford. I conducted work in AI-based planning systems using the domain of experiment design in molecular biology. This research was sponsored by the National Science Foundation. My goals were both to improve on then-current planning technology and to better understand the cognitive science of how expert human scientists design and modify experimental plans. One of the reasons for picking molecular biology as a domain was that we believed prior work in planning focused too much on combinatorics (that is trying huge numbers of possible sequences for a plan with the individual steps being very simple operations—this was normal in a robot action planning domain) and not enough on domain-specific knowledge. It turned out the planning system I developed was able to almost completely avoid combinatorics and backtracking by utilizing knowledge-rich "skeletal plans" that served as the basis for whole classes of experiments. The work was published in the Journal of Automated Reasoning and the premier AI conferences, illustrating its merit as basic research.

    However, the even stronger legacy of the work came from what started out as a small sidelight of the planning research. At the time, the field of molecular biology was in a rapid transition from an essentially qualitative science to a quantitative one. Where previously it had taken tens of man-years to collect a few dozen base-pairs of DNA sequence data (the strings of the letters A, C, G, and T

that represent the genetic code), two new technologies (both of which won their inventors Nobel prizes) suddenly made it possible to gather thousands of base-pairs of data in days. My biologist collaborators in the experiment design work needed ways to analyze that data which enabled whole new classes of experiments. That software, which was relatively easy to develop, "bought" me so much additional time with world-class biologists that it greatly facilitated the cognitive science aspects of my planning research work. But it also started a whole field of bioinformatics with the software first distributed to the academic community through NIH sponsorship of a National Computational Research Resource called BIONET, and then to the commercial community through a company called IntelliGenetics.

Challenging Problems and Common Data Sets

Certainly, all basic IT research doesn't directly result in immediate mission-critical applications. As in other fields of research some work can take a long time (if ever) to mature to the point of practical utility. However, I think it does illustrate a few points that I think allow simultaneously to provide for very high quality 6.1 work, maximize the potential of eventual practical utility, and minimize the time for that technology transition. Most importantly, I believe the three goals are synergistic—thinking about the latter two make the 6.1 research better (and at least in the case of basic IT work at NASA, made so many friends among the mission-oriented end users that it caused NASA to multiply 10-fold its initial basic research funding for intelligent systems research).

- If at all possible use real problems and real data sets to drive IT research. The problems may need to be simplified and the data sets abstracted, but the danger of using "toy" data may be solving problems different from those posed by the long-term real-world challenge. This was the case in the planning work discussed above—the majority of the then current AI planning community was solving a problem mainly irrelevant to the long-term challenge. The inherently risky nature of basic research means that all work will not succeed, but it's a terrible shame if the research "succeeds" and the problem solved was the wrong one (and better initial analysis would have prevented that).

- Technology transfer can (and should) often be accomplished by the research scientists themselves. Because the bulk of IT research is invention, the transition from researcher to implementer is far easier and more common than in other basic science fields. One has to only look at the number of Computer Science PhD theses from Stanford that led within a year or two to a venture-backed software companies to see the truth of that statement. For the USAF that suggests that a separate IT development laboratory that acts as the interface between research and applications is not always or even normally necessary; the research scientists themselves should be encouraged and facilitated to work with potential end-users from the initiation of many 6.1 projects, first as suppliers of domain expertise and data for the research, later as users of the technology.

- Of course, the nature of the eventual application will dictate how much implementation work can be directly accomplished by the researchers, and how much they can merely facilitate. We don't expect academic computer scientists to write validated flight code, but we should expect them to help educate the contractors who use their technology to produce flight code.

- For certain research topics, providing common data sets and test beds for AFOSR-funded IT researchers can provide a major impetus to the research. In areas like scheduling, discovery, and physical systems modeling this is particularly true because such a research infrastructure provides a way for measuring success. It also helps creates a community of scientists with a common interest and encourages sharing of intermediate results and methodologies. The approach has worked well in many areas of IT from challenge databases for machine vision research to the RoboCup problems that spur work in robotic planning and mobility.

Core Topics of Long-Term Importance to the USAF

My preliminary thoughts in this area are based on many years of work at NASA that was often in collaboration with USAF people and laboratories. While NASA's primary missions are scientific discovery and exploration and the USAF's primary mission is defense and war-fighting, the two organizations share many common problems in developing, operating, and maintaining extraordinarily complex vehicles in air and space.

Both share the logistical and infrastructure challenges of any large governmental organization. I believe there are seven primary areas where basic IT research sponsored by AFOSR will be key to future USAF missions over the next twenty to thirty years:

1. Design, operations, and diagnosis of complex electro-mechanical devices—air and space vehicles, weapons systems, etc. IT topics include knowledge representation and management throughout long product lifecycles, automated and human-assisted diagnosis techniques based on underlying physical models, automated vehicle health systems, and automated design tools.

   It appears that the current AFOSR program is seriously lacking in this key area. Given the nature of the AF missions, I would make this my most important priority for a new IT research thrust. NASA has a long history of work in this area ranging all the way from very basic explorations both inhouse and in academia to flight tests on deep space missions. In the past there has been considerable collaboration with the AF missile programs on automated vehicle health monitoring. Unfortunately for the last four or five years the longer-term more basic side of the NASA program has been nearly eliminated, although there are still a corps of experts who might be enlisted to help AFOSR. NSF continues to support work in qualitative physics.

2. Software design, testing, and maintenance as well as adaptive software systems. Over the last few decades, all of our vehicles (whether automobiles, jet fighters,

or space shuttles) have become as much software systems as hardware ones. Building and testing that software is an enormous and growing task, and software capabilities seriously lag our hardware potential.

AFOSR does have a program manager with primary responsibility for systems and software. I believe he intends to significantly expand work in several of the topics I listed above. I recommend that his program establish a testbed to allow a wide variety of s/w validation and verification methods be measured against realistically complex AF relevant flight software. NSF and DARPA have been leaders in this area and, I believe, would readily partner with AFOSR.

I also recommend that consideration be given to fund basic work in adaptive software (such as that which could automatically reconfigure flight controls during emergency circumstances—NASA already has a small program in this area that could be leveraged).

3. Battlefield situation assessment and decision-making. This includes IT work in information fusion, machine learning, and cognitive modeling. AFOSR currently supports various pieces of this topic under at least three different program managers. Again, I think it would benefit by providing grantees with some common datasets and challenge problems as a way of measuring research progress.

NSF is the major supporter of fundamental work in machine learning and cognitive modeling. Partnership with the head of the Intelligent Systems Office, Haym Hirsh, has already been discussed, and he is eager to collaborate. The current head of the DARPA, Charles Morefield, is a well known expert in information fusion, and with the recent addition of Doug Cochran as an AFOSR program manager, I would think DARPA collaboration would be a lively possibility. While the work is somewhat less accessible, the intelligence community is also a potential partner.

4. Human-machine interaction. Research on how to facilitate the linkage between people and the increasingly complex devices they operate. This includes both software and hardware research as well as cognitive science work. Given how critical humans-in-the-loop are to most AF missions, I'm a bit surprised that there isn't more emphasis here in the current AFOSR IS program. I recommend expanding that effort substantially with the addition of a dedicated program manager.

ONR is a potential major collaborator in this area. Terry Allard, who used to head the human factors division at NASA Ames (the government's largest aerospace human factors laboratory) is now head of the warfighter performance division at ONR. NSF is a major funder of work, also, and has already expressed strong interest in co-funding research, particularly when it involves collaboration between US and foreign laboratories (since NSF is mostly barred from directly

funding the non-US side of such collaborations).

5. Operations and Logistics. Research on better ways to schedule and optimize resources, plan and coordinate battlefield operations, and manage the incredibly complex logistics of the AF supply chain. A variety of IT work from numerical/OR based methods to AI approaches are relevant here. While this area is touched on in the current AFOSR IS program (mainly on the algorithmic side), I don't believe it has the emphasis it deserves, given the long-term benefit to AF missions. I would recommend creating a program specifically for this topic.

   NASA has been a major player in this arena, unfortunately, NASA's long-term program in this area has suffered as described above in other topics. NSF is probably the current partner of choice for AFOSR.

6. High-performance computing and networking. Modern aircraft are almost entirely designed and tested through computer modeling—this has been one of the major drivers for Tera and now Peta-flop supercomputers at NASA. Research on designing both the hardware and software of such machines has been a government-wide thrust for at least a decade. While I don't see the need for AFOSR to lead here given how much work goes on elsewhere, I am a bit surprised to see quite a bit of innovative research funded in networking by AFOSR but very little in high-end computing. I would recommend expanding a bit here so as to make AF challenge problems part of the suite of test data for

measuring success in supercomputer development.

DOE, NSF, and NASA have been the key agencies in supporting high-performance computing research and technology development in the last decade. I'm not sure if AFOSR is currently active in at least staying knowledgeable about work funded by those agencies, but if not, I would recommend it become so.

7. The IT "business infrastructure" of the USAF. Research on how to use the desktop IT infrastructure to make the day-to-day operations of procurement, personnel, finance, etc. more effective. In particular, there are many potential investments in basic work on next-generation internet-based technology for effective communications, knowledge management, regulatory compliance, and a host of other topics. In addition, work in cybersecurity falls under this area. I would also include research on telepresence systems and human-avatar partnerships as longer-term topics. My initial observation is that AFOSR has a very serious and well-managed cybersecurity research program, but very little in any of the other parts of the IT infrastructure.

This is an area where I have observed that US government agencies across the board badly lag the private sector. Take the area of knowledge management where I have personal experience from founding and leading a major commercial vendor from 1995 to 2003 (Intraspect Software). While there has been some penetration into government agencies, mainly the intelligence community, by and

large government lags business by almost a decade. The currently Presidential

administration has served notice that it intends to see this rather sorry state-of-

affairs change with the appointment of a government wide CTO. I believe that

AFOSR has a chance to step up to help fill the current government vacuum here.

People to People Artificial Intelligence Delegation to China, October 26-November 7, 2008

The delegation leader was assisted in note taking by the following delegates:

Steven Blageff, Becky Collins, Danie Crevier, Elize Ehlers, Albert Esterline, Peter Friedland, Stamos Karamouzis, Sreela Sasi, Peter Sprecher, Richard Wallace, Jing Xiao

Bejing, October 29, 2:00pm.

Chinese Association for Artificial Intelligence (CAAI) Visit—

The Chairman, President, Vice President, etc. were present.

X.Y Zhong, President of CAAI started a roundtable of discussion. Initially, self introduction took place. The President gave an introduction to CAAI's vision. CAAI has 5000 members, comparable to AAAI, which has about 4,000 members. CAAI is 27 years old. CAAI thinks that Artificial Intelligence (AI) is the frontline of Intelligent Computer Technology that is able to provide human society with intelligent tools for the industry to transition to the information age.

The mission of CAAI includes the following:
-   Explore the secret of natural intelligence

- Produce intelligent machines

- Utilize intelligent tools for education, research, and engineering

- Apply intelligent tools for peace focusing on reducing the gap between developing and developed countries

CAAI has 'Office' and 'Secretariat' that consist of a number of 'Task Groups' and 'Special Interest Groups'. Task groups focus on promoting AI in education, industry, robot soccer etc. Special Interest Groups have identified 21 areas that include Affective Computing, AI in Education, AI Theory, Biological Informatics, Discrete Mathematics, Extenics Theory, Intelligent Aerospace, Intelligent Computer Access, Intelligent Control, Intelligent Management, Intelligent networks Intelligent Optimization, Intelligent Robot, Intelligent Systems, Knowledge Engineering and Multi agent Systems, Machine Game, Machine hearing, Neural Networks, Natural Language Processing / Natural Language Understanding, Rough Sets, Virtual Reality etc.

Major CAAI activities:
- National Conference on AI (500 participants)

- International Conference on Advanced Intelligence (300 participants) in 2006

- International Conference on Natural Language Processing and Knowledge Engineering

- International Conference on Humanized Systems

Publications:

- CAAI Transaction on Intelligent Systems - (Chinese)

- CAAI Transaction on Intelligent Technology - (Chinese)

- CAAI Transaction on Intelligent Science (in preparation) -(Chinese)

- International Journal on Advanced Intelligence (in preparation) – (English, supported by Japanese University)

- Book series: AI Progress in China - (Chinese)

- Text for Teaching: Artificial Intelligence in Science & Technology - (Chinese)

- Magazine: AI and Modern Society - (Chinese) in preparation for educating the public

Organizationally, since A.I. was considered as a "brain" activity, it was part of the social sciences. However, later on it was recognized that AI is part of computer science and in 2001, CAAI was moved to China Association of Science and Technology (CAST) society; interest in CAAI's activities interest has grown since then.

There are also more than 10 Regional associations dealing with AI but they are are working mostly independently. CAAI has some connection with them. CAAI is currently accepting foreign members. CAAI is looking forward to associating with AAAI.

About 1000 students are doing graduate studies in AI. Approximately, 300 Ph.D.s are graduating every year. Government initiatives are currently available for supporting research in AI through indirect funding. Funding – CAAI has no funding for students; members have to pay to join the society with a small contribution; CAAI is open to foreign members and there are a few; CAAI is an NGO (non-governmental organization)

Activities in Education:

- Promotion of Undergraduate Education in AI

- Promotion of Graduate Education in AI

- Elementary education of AI in secondary schools

- Workshops in AI Education

Activities in Research:

- Encouraging innovation and creation in AI research

- Submitting proposals to Ministries / Foundations / Enterprises

- Giving Awards to Excellent Researchers

- Organizing groups for advanced research

Activities in Industry:

- Channeling Universities / Institutes / Enterprises towards AI

- Providing Education / Training Services to Enterprises

- Introducing new results in research to enterprises

- Providing consultations for enterprises

Outstanding results achieved in AI: According to CAAI

- Theory of Universal Logic

- Contradictory Set Theory

- Intelligent coordination for complex systems

- Bionic approach to Pattern Recognition

- Knowledge Ecology Knowledge Theory

- Mechanism approaches to AI – A Unified Theory of AI

- Advanced Intelligence (Intelligence / Emotion / Consciousness) etc.

- Application of AI in Socio – Economy

- NL Understanding for information retrieval

- Intelligent Robot for entertainment and home services

- Machine Translation for international cooperation

- NLU + Affective Computing for education

- Intelligent Optimization for sustainable development and self-organization

- Self adaptation, self learning and self organization for industry

Selected achievements:

- Prof. Xu: First Expert System for diagnosis and treatment of hepatitis (1976)
  using Chinese traditional medicine in the Institute of Automation, Academy of
  Sciences of China

- Text book of AI in China (AI and its Application (1988) by Electronics Industry
  Publishers)

- AI – Review and Forecast (2006) sponsored by CAAI

- Artificial Life and its Application (2002) – First Symposium sponsored by CAAI

- Softman Research and it Applications (2007)

- Humanized Systems and Humanics (AI & Robotics) – International Symposiums
  (2004, 2005, 2006, 2007, 2008)

Some hot topics according to CAAI:

-Extenics Theory - Extenics is a new science. Experts in China established it. Extenics runs through natural sciences and social sciences. The objective of Extenics is the solving of contradictory problems of the reality world. This is currently a very hot topic in China.

-Intelligent Optimization - more suited for processes involving many variables. It involves problems concerning varied conditions for optimization versus fixed condition problems.

- Information Communication Technology (ICT) – link information and A.I technologies together to make them more enabling to society. Information age or knowledge age and the industrial age are bridged by A.I. through "intelligent" tools

Some efforts to get associated with or included in IEEE:

- Some effort has been made to touch base with IEEE. The president has talked with them to set up an AI society under the umbrella of IEEE, but the relationship is very complicated. There are so many societies, and all of the other societies must vote to allow a new society to come into the fold.

The visit ended with exchange of gifts and picture taking.

Bejing, October 30, 9:15 am

Tsinghua University-

The university delegation was headed by professor Sun Maosung, dean of the Computer Science and Technology Department. In addition, the following professors attended:

Andrew Lao/Conmplexity Theory – Academician, US Academy of Sciences,

Zhang Bo/AI – Academician, Chinese Academy of Sciences

Li Sanli/Computer Architecture

Sun Jiagjuong/Computer Graphics

Zhang Kaoure/Computer Architecture and Networks

Following a brief welcome by Professor Sun and a few introductory words by Professor Sycara, the delegates introduced themselves.

Professor Sun then described the Computer Science Department. It was established in 1958, and is rated by the Chinese Ministry of Education as the best of the approximately 800 computer science department in Chinese universities. It comprises 90 faculty members, which is considered medium size in China. Five of these faculty members are academicians of the Chinese Academy of Sciences. There are 685 undergraduate students 403 Ph.D. students, 423 full-time Master degree students, and 333 part-time Master students. 100 undergraduate courses are offered, and 60 graduate courses. The research budget amounts to 14 million US dollars, and is provided in part by multinational companies. International exchanges involve 455 students and professors from abroad.

The department is number 12 in world ranking in terms of number of papers published in Computer Science but in terms of the number of citations, it does not rank very highly. 1585 papers were published in 2007.

In answer to a question from a delegate, professor Sun states that for top conferences, the University will provide funding in order to allow students with accepted papers to attend. There are numerous research projects in progress involving international cooperation, including collaborations with Microsoft and Google. There is also significant international exchange, with 455 students and teachers going abroad, with 50% being students. A student team received a 2nd place gold medal in a 2007 ACM competition involving 700 teams.

Five Research Institutes have been established within the Computer Science Department:

- **Networks/Internet Architecture** – The Internet II project involves research in the next generation internet development in China.
- **High Performance Computing** – China has set up a large project at the national level, involving a 6 region strategy. Projects include embedded microprocessors, network storage architecture, and also research in grid computing with many large cities connected.
- **Software** - Web mining and Web data integration, Semantic Web, ARNET Mines, provides information on social relationships and publications in the academic world, at www.arnetmines.org.

- **Human/Machine Interaction and Media Integration** – Principles of human centered HCI, Biometrics, Information Fusion, Smart Space, Affective computing. Some of the technology developed is used in camera products by companies in Japan. Also research in text to visual speech and emotion conversion, whereby text is input and one can infer from the text and translate into an emotion. ETTS, embedded Mandarin, music retrieval. Also, research in areas of computer graphics, digital media processing

- **Intelligent Technology and Systems -** Pervasive Computing – Information Appliances, Embedded systems, Sensor networks, Software Infrastructure for pervasive computing. National Key Lab of Intelligent Technology and Systems, this is a unique lab in China, awarded three times for grant excellence. Theoretical AI, quantum computing (Transactions of Information Theory).

Other projects: Digitization of Chinese Ancient books, Speech recognition, Natural language Processing, TMiner (large scale text analysis), TREC (Text Retrieval Conference), Video Retrieval, Assistance Software for disabled (blind) Chinese ←→ Blind Text, Application oriented robotics, space robotics, service robotics.

Auto Car (THMR-V) the hardware is not so advanced, focused more on software. Next generation will upgrade hardware with better funding.

Professor Sun then took questions from the delegates.

Q. Is the Future Internet project part of an international effort?

A. There is cooperation with Japan, Singapore, and Europe.

Q. : Where do your graduate students come from, China or overseas?

A: 20% of our undergrads pursuing graduate work go to the US. The rest stay in China. While it was true that some of that 20% previously would go to Europe or Japan to study, the US now predominates. $1/3^{rd}$ or our graduate students come from Tsingua, 2/3rds come from other universities in China. Tsinghua has a special program that attempts to match students with professors.

Q: There was not much on software agents/autonomous systems in your presentation?

A: We are engaging in some research in Mobile robots and Navigation Software.

Q: Concerning Image processing, how do you separate Foreground/Background? Are there any papers?

A We have had 2 or 3 professors working in the field for 20-30 years. For imaging problems, we extract low level features and try to combine image information w/text to improve image retrieval results.

Q. How do you attract graduate students?

A. Students tend to follow the research interests of professors.

Q. Do you perform research on autonomous systems?

A. Yes, mainly involving software agents.

Q. What kind of work is done in image processing and segmentation?

A. There are two or three professors with about 20 years of experience in the field. Professor Sun is not very familiar with their work, which involves extracting low-level features, and linking with semantics and textual information.

Q. Is there research on ontologies and knowledge retrieval?

A. Professor Sun thinks ontologies are used for work related to video. Word Net is used for other work. There is a Chinese equivalent to Word Net called How Net.

Q. What expenses does the $14 million in research funding cover? Can it be used to increase faculty salaries and student stipends?

A. Salaries are rather low, and the University allows professors to get money from research funds, except on some government funded projects. Internationally funded projects allows higher salary increases. The research money can also be used to pay student salaries, or hiring people from outside the university. In national projects, a small percentage is set aside for individual researchers (5%). For international projects, this is somewhat more. Core salaries for faculty are paid by the government.

Q. Where do the part-time students come from?

A. From companies or other research institutes.

Q: Is research a requirement in the undergraduate program?

A: for the total 4 years, the last ½ year is reserved for research. There is no course work at that time. There is also a separate program , which is optional for students.

Q: What is the difference between the Masters of Science and Masters of Engineering?

A: the Masters of Science is a research degree. The Masters of Engineering is primarily for part time students who are working in industry. It is more of a part time degree.

Q: Is there funding for international collaboration?

A: Yes, there are 2/3 projects with EU countries. Not clear about other parts of the world.

Q. Where does the international funding come from?

A. Mostly from Europe, Singapore and Japan. Very little comes from the US.

Q. Why?

A. The NSF has an international program that supports travel only, not students. You must get funding individually. Because it is decoupled, it is difficult. Also, US gets many of the best students. It is a dysfunctional system. If a US agency would be willing, the Chinese would welcome that.

Q. Has China set up large research projects in computer science?

A. Yes. For example, a $30 million effort for a new operating system.

After the end of the question answering session, there was gift exchange and picture taking. The delegates were invited to view posters describing research by Tsighua members of the Computer Science department.

Bejing, October 30, 2:00 pm

Bejing Institute of Technology (BIT)

The director of University relations gave a short overview of BIT.

BIT is one of the top 35 universities out of 2, 350 universities in china. Currently, there is a main campus and also campus in suburbs of Bejing. BIT was supported in the 50's and had relations universities in Russia and it still has partner universities there. Its logo was first eagle because it was connected to defense now it has dove as logo.

The 986 project AI MED had as purpose to establish research oriented universities and BIT was one of them to enter this and also 211 project.

BIT has over 42,000 students 22,000 full time but also distance learning, 12,000. There are some English taught classes in the distance learning; many foreign students study Chinese. It has 1927 full time faculty, 15 of whom are members of the Chinese academy of science. It has graduated 2,444 doctorates and 5,222 masters also many international students from Asia and Africa. BIT has strengths bot in theory and applications. It also has the best soccer tam in China (7th in the world). The ratio of women students to men is 2:1. BIT is comprehensive university with 13 academic schools many of them in engineering. Total funds in 2007 were 908 million rmb.

Very good research in robotics, e.g. robotics humanoid, robot for martial arts etc
Cooperative relations with 118 universities in 39 countries
Relationships with more than 100 companies eg Google, Microsoft etc

Afterwards, Prof. Zhendong Niu gave a presentation about the Digital Libraries project in China that he directs (Dr. Niu's slides are attached).

After Dr. Niu's presentation, there was exchange of professional cards, gift giving and picture taking.

Nanjing, November 3, 2008-12-13

Nanjing University, 9:10 am

The delegates were welcomed by Dai Zhi Huu, deputy director of International office of Nanjing University. Mr. Dai is involved in Higher Education Research. He introduced staff of Computer Science: Professors and Ph.D. students.

The delegates from People to People delegation introduces themselves and give brief discussion of their research.

Chinese counterparts research includes ontents based image retrieval, intelligent multimedia processing, NLP, image processing.

Mr. Dai then introduced Nanjing University:

Private University Nanking, 1888 American missionaries

Public National Central University of China, 1949

Strong in Social and Sciences, have a developing engineering program

The Natural Sciences that are taught in the university include Physics, Geology. Computer Science since 1958 – this year 50th year anniversary of   Computer Science program

- State key lab in Computer Software and novel technology

The students are of high level Top 1.5 % of examinees of National entrance examinations.

½ of students will study abroad   }   Masters and Ph.D.

⅓ for Peking or Tinghua University

In terms of staff, there are 34 Members of Chinese Academy of Science Among top universities in China. Also in the category of National young Scientists – the university is number 3 in China

1992 – 1999 Natural Science no. 1 in terms of publications. Currently a medium University

24 000 students   13 000 Undergraduate students   }   Research University

           11 000 Graduate students

Output – No. 1. in Chinese Universities (Per Capita). In terms of State Key Labs - 6½ (3rd in China). The University has many International Cooperation: 260 relationships of which 50 are very active.

- Joint venture with American John Hopkins university
- ½ of US diplomats in China are graduates of the above Centre.
- 2 year Master program in International relationship – open for 50% international students.
- Sino/ German legal studies centre

- Tokyo – Human/arts education

- Encourage faculty exchange, international conference student exchange – (target 10% of Nanjing University students) to have national learning experience.

- ± 2000 international students annually

- 400 of which will be for degree studies

- Largest group of USA students in China

- 600 (USA) each year – subject courses: international business, politics, relations

- John Hopkins – all courses in Chinese for international students

- Chinese students take courses in English, but not yet in Computer Science

General discussion and Q and A followed on the following subjects:

Tuition fees

- General ⎫ 4600 RMB per year (20% of total expenditure)
- Human ⎬ 700 US $

Science

  - Engineering – more
  - Arts – higher

They want to strengthen programs with Canada – Lowers tuition fees for programs to be promoted. There are existing ties with the University of Waterloo Sino/ Canadian College

2 year program Computer Science GIS Env. Studies – waiting for approval from Ministry

Annual funding – excellent students to study abroad. Money from government, university, students themselves, negotiate with partnership universities for exemption from tuition fees.

In terms of Sponsored research funds – 600 million RMB per year

  - ⅓ from Government

  - ⅔ from other sponsors, tuition, etc. research grants

But they are starting to get funding from outside companies, Microsoft Asia, IBM < 20K US $ (innovation award). However this funding has not yet provided for student scholarships. So. Funds for supporting, e.g. attendance at international conferences comes from research funding of students' research supervisors.

They also have specialized schools of distance education. Undergraduate research – encouraged – integrated in programs. Computer Science in 4th year – need to prepare a thesis – each student is assigned a supervisor – select a topic they are interested in. Each Prof – 3 to 6 4th years to supervise. Exchange student program with foreign undergraduates – may go abroad for 1 semester to institutions.

Information about the Computer Science department:

- 1958 : Programme (one of the oldest in China).

- 1978 : Department's 30 year anniversary.

- 100 Faculty members:

- Most respected for both teaching and research.

- 20 Full professors. Only full professors can supervise Ph.D. students

- Associate Professors must be evaluated for graduate supervision by a committee.

- Criteria are: research project funded and publications in high impact international journals.

- Good research output, among 7 key Computer Science departments in China.

Students

- 200 graduate students (around a 100 are PhD students)

- 500 undergraduate students

Nanjing houses a Key Lab – Software and Novel Software was No. 1 evaluated by government 8 million RMB.   Criteria for key labs - Research output. How many good students graduated

Artificial Intelligence – 6 Faculty members in Artificial Intelligence. Also in other groups

Research groups: MM Processing

Distributed computing

Pervasive computing

Software + automation key lab

Artificial Intelligence

Software

Prof – teach 2 or 3 courses each year

Ph.D. 1st semester some course work $\rbrace$ ± 3 years (could extend without funding)

Novel software State Key Lab

- Distributed Computing

- Machine learning and support software

- Multimedia processing – in the widest sense

Funding

Funding by Microsoft – government now encourages joint basic research. Microsoft gives top young research Professors funding – can do any research.

China – NSF – general project 400 000 RMB for 3 years.

3-5 graduate students. Each graduate student does technical assistant work for 1 semester

Key project program 1 – 5 million RMB for 3 years

National outstanding youth fund – faculty members received 1 million RMB for 3 years

Innovation team – 5 million RMB

M & Ph.D. – good scores – students do not have to pay tuition, get money- salary enough for living expenses

Grants allow for: international conferences < 30%,

Money on students < 20%.

Professors salary is not supplemented if the source of funding is the government.

However, industry money can be used to supplement salary.

Ph.D.'s who graduate – 50% enter university or Researched Institute

- 50% industry

- Ph.D. program less competitive than Masters degree

Part-time Ph.D. program takes longer.

The university plans to make extensions – new campus for freshmen – when completed
can enroll more students.

Staff Recruitment

 Academics recruited – Ph.D. in Computer Science – submit applications to personnel office. There is an academic selection committee – similar to US. Advertise – website. All Associate Professorships and above open internationally. Currently some professors are with US or Canada citizenship. Academic staff contracts are renewed every 5 years – if you meet minimum criteria. Retirement age is 60.

In terms of student scholarships, there are 30 universities that take part in project 985 for international scholarships. Elite Universities, like Tsinghua have 200-300 places. Nanjing University has 150 places, 75 for degree seeking candidates and 75 for cultural experience. But these scholarships require the student to return to China after finishing. So, many students prefer to seek scholarship directly form US Universities.

Areas of research in semantic technologies:

Knowledge representation – do work – based on semantic based image retrieval – WORNET – using text to represent image (colour/ shapes/ textures)

The visit finished after gift exchanges and picture taking.

Nanjing, November 3, 2008

Nanjing University of Aeronautics and Astronautics (NUAA)

On November 3, 2008, the People to People delegation to China visited the Nanjing University of Aeronautics and Astronautics (NUAA). They were received by the Director of the international Office, three faculty members, twenty-some graduate and doctoral students, as well as recent alumni.

The director of the International Office greeted the delegation and briefly introduced the university. NUAA is located in the East part of Nanjing at a site of a Ming Dynasty palace. It was established on Oct. 20, 1952 as the Nanjing College of Aeronautics Industry. In 1993 assumed its current name. Currently NUAA serves 26,055 students with 2,707 faculty members.

The 26,055 students are divided into 16,149 undergraduate students, 4,814 graduate, 1,042 doctoral, 3,940 vocational, and 110 are overseas students. Four hundred students get training as commercial pilots by studying 4 years at NUAA and then one year of practical training in the USA. Three hundred fifty students are international students, mainly from Asia, studying at the College of Global Education. Every student is required to learn English within their first two years.

The 2,707 faculty are divided into 232 full professors, 539 associate professors, 850 lectures, 277 teaching assistants, and 809 teaching staff.

Nanjing College of Aeronautical Industry (1952-56). Nanjing Aeronautical Institute (1956-93). 14 colleges.

- College of Aerospace Engineering is the strongest.
- College of Energy and Power Engineering (with strong relation with Ford).
- College of Automation and Engineering.
- College of Information Science and Technology.
- College of Mechanical and Electrical Engineering (very strong).

- College of Material science and engineering.

- College of Civil Aviation.

- College of Science.

- College of Economics and Management.

- College of Humanities and Social Sciences.

- College of Arts (newly established in 2003).

- College of Foreign Languages (English and Japanese).

- College of Global Education (teaching international Students – 350 international students studying software engineering, aeronautical engineering, mechanical engineering, international business in masters and PhD programs. Taught in English. Also for joint program students for graduate programs).

- College of Space Engineering.

The university offers 9 national key disciplines (including Design, engineering mechanics, etc.), 18 provincial key disciplines, 12 post-doctoral stations, 52 doctoral programs, 127 masters programs, and 46 bachelor programs of study. NUAA has 56 labs, including 15 national and provincial key labs. The university research is focused into various areas in aeronautics that include UAV design, structure vibration, aviation power, ultrasonic motor technology, etc. The university has graduated more than 70,000 students; it hosts 6-10 international conferences each year and invites more tha 100 international scholars for research collaborations.

Upon completion of the university's overview the members of the people to people delegation introduced themselves within the context of their professional affiliation and research interests. In return the NUAA faculty, students, and recent alumni introduced themselves.

The majority of the Chinese colleagues expressed research interests in sensing structural integrity, vibration control, piezoelectric technologies, etc. In terms of AI technologies data mining, machine learning, and pattern recognition were the predominant areas of interest.

The remaining of the time was dominated by a dialog on research interests and directions. The People-to-People delegation leader asked if the emphasis on machine learning was propelled by a specific government direction. A professor replied that that was true. It was easier to get funding for this area. A current AI application was detecting defects in aircraft structure. Another is shape optimization. It was observed that there is no very direct link between the AI group and the application in aerospace areas. The AI group is trying to establish the link. The group is growing. It was initiated by one professor and now has 6 faculty members. NUAA faculty expressed an interest in being helped by their US colleagues in identifying machine learning applications in aeronautics. Additionally, it was mentioned that NUAA has a loose relationship with the Chinese Space program but such a relationship is growing.

Prof. Jinhao Qiu, Director of the Aeronautics Science Key Lab, joined the group. he mentioned that the labs major research initiatives are in structural health monitoring, adaptive smart structures, and structural vibration control. The lab is comprised of 11 faculty members, 100 master students, and 40 doctoral students. The faculty member representing the AI group mentioned that the group is comprised of 6 researchers and it is growing in size and scope. One question was whether a multi-agent or a centralized approach was used. The answer was that some host researchers were investigating multi-agent approaches. One student works in that area, using many sensors. One question was whether civil aviation could use AI approaches for traffic planning and control. The host has no group currently working on that issue, however the lab has some collaboration with Georgia Tech.

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The meeting concluded with gift exchanges and commemorative picture taking.

Shanghai, November 5

Pudang Software Park in Zhangjiang hi-tech park

Spsp development company. Pudong Software parks since 1992

Spsp ltd 1998

Spsp corp ltd 2007

Provides infrastructure, helps facilitate next phase of start-ups in finding funding (including govt support, foreign investment). (In an earlier phase start ups themselves can also sometimes apply for grants from the government, and seek other investors.)

Development from 3.3 ha in phase 1 (2000), 9 ha in 2002 (phase 2) while in phase 3 (2010) it will be 60 ha. The phase 3 development will include residential area, lake, sports facilities, park, restaurant, Shanghai ZJ Institute of Technology (education), hotel, green coverage 61.6%, infrastructure – subway, schools within zhangjiang park

Kuanshan subpark due to be completed in 2012 with a building area of 67.5 hectare

Sanlin world expo sub park, 17.000 m2 to be completed in 2008

Total zhangjiang hi-tech park is 25 km2 and includes financial district, export, open area in addition to spsp

Export volume 220 million dollars in 2007, over 200 companies with 12.000 employees, many from outside China, 40% in phase 2

Sales volume in 2007 130 * 100 million RMB

SAP (1st), CITI, AIG, EDS, Capgemini, ILOG, Infosys, HCL, Sony, kyocera, tat, ….

Work is mostly in software development. Chip-design, information security, software outsourcing, system integrity, finance, telecommunication, embedded software

Options for companies regarding buildings: Rent a building, build to suit, purchase existing.   Most rent: Rent ranges 3.5 – 4.5 rmb per day/m2 rent

20.000 – 30.000 students science and technology graduates per year in the whole area of Shanghai

Universities can get grants for training company employees. Also the Chinese governments support training in China by foreign experts.

<u>Shanghai November 6 (meeting got switched form Nov 5 to Nov 6)</u>

<u>Shanghai Computer Society (SCS)</u>

Our delegation was welcomed by members of the AI committee of the SCS:

Prof. Duoqian Miao	Tongji Univ.	speciality: ubiquitous computing
Prof. Chen	Tongji Univ.	speciality: AI and pattern matching
Prof. Cao Qiying	Donghua Univ.	speciality: biological inspirations for AI
Dr. Song	Tongji Univ.	speciality: AI and pattern recognition
Dr. Wong	Tongji Univ.	speciality: data mining, privacy management

According to Prof. Duoqian, the AI Committee has 300 members. It is headed by Prof. Jiang, who could not attend the meeting. The Committee includes representatives from industry and also graduate students. The Committee is a branch of the Chinese Association for Artificial Intelligence. About 50 universities are represented in the Committee.

The main discussion took the form of questions by either members of our delegation or by the SCS AI Committee members.

I. Questions by People to People delegation:

A. Academic.

1. Q: What are some of the 'hot topics' in AI in China?

  A: machine learning, grid computing, multi-agent systems, data mining

2. Q: Are university departments research or application oriented?

  A: (Here, we didn't get a satisfactory answer, although some of the other

    answers bear on this question.)

3. Q: In research on natural language and semantics, are ontologies used either for

    querying (retrieval) or for analyzing the information retrieved?

  A: Ontologies are being used in both capacities.

4. Q: Could you give us some details concerning biologically inspired computing?

  A: The main focus has been on vision. This includes attention (perceptual

    grouping was also mentioned in this context) and eye movements. We have

    considered both psychological and neurophysiological studies. This work

    has received funding from the NSFC.

5. Q: Are there collaborations with other universities abroad?

   A: Tungji Univ. is involved in Sino-Italian (Milan), Sino-German (many schools),

     and Sino-French (incl. INRIA) programs. These are "2+2" programs, which involve

     2 years at Tungji and 2 at the collaborating university. There are programs of this sort

     in the fields of "electronic information" and mechanical engineering.

     There are also some exchange programs with universities in the US, Australia,

     and India.

B. University/Industry

1. Q: Name some challenges in pattern recognition.

   A: Quality control for textiles. (In this connection, it was mentioned that

     Tingji Univ. was originally a "textile college".)

2. Q: Could you give some examples of the transfer of AI research to companies (act.

    real-world applications)?

   A: i. An intelligent public system for facilitating traffic flow that determines

      the locations of traffic jams and informs drivers by posting the information

      on bill boards. The system uses grid computing. It was originally funded by

      the Shanghai Municipal Government, which provided 10M RMB for a first phase

      and 20M RMB for a two-year second phase. Apparently, the project involved

      collaboration with Tsinghua Univ.

ii. A cell phone/internet system that is also used to broadcast traffic information, that will be used in other Chinese cities in addition to Shanghai. The service is currently available for free. After Phase II it will be fully commercialised. (Obviously, this is closely connected to the first project; perhaps it is part of it.)

3. Q: Is it possible to commercialize research ideas? Could you say something about how this is done?

A: It's evidently possible. A problem is finding investors. It's also possible to collaborate with international companies. Government support is also available, up to 10,000 RMB.

Some examples were given: (i) a cooperative endeavor with microsoft on embedded systems, (ii) a project concerned with the semantics of domain-specific Chinese, (iii) a project on a Chinese search engine with a local company.

4. Q: Could you say something about energy management and logistics?

A: Petroleum and steel industries have special units for research in optimizing energy. There is a focus on both scheduling and optimization. The Chinese government has emphasized the importance of such research.

5. Q: Has there been any collaboration with the aerospace industry, e.g. on unmanned aircraft?

A: Donghua University has its own UAV.

6. Q: Can you say something about IP ownership?

   A: In the academic context, IP is shared by inventor and the university. Usually it is 30% for the inventor; but if the inventor does not use any University support, such as University facilities, then the inventor can get around 70%. However, if the work is done for a company, then the company owns 100% of the IP.

7. Q: Are there public relations events to sell AI to industry?

   A: There's not much of this. It's something that should be done more.

8. Q: What industries have invested most heavily in AI (top 2-3)?

   A: Banking and security - use data mining. These companies have their own staff for developing this application.
   Shipping (I wasn't clear what the application was.)

I. Questions by Representative of the SCS AI Committee

A. Academic.

1. Q: Do US universities use data mining to assess student records? (In clarifying remarks, Prof. Chen explained that the applications of interest included such things as determining why students don't graduate, and student success in

relation to course assignments.)

A: Neural networks and support vector machines have been used to study

patterns of retention and graduation. Data mining has been used in connection with

fund raising and travel advertising, including specific categories of these. In addition,

some collaborative effort of US Universities with industry to develop a layer on top of

Banner were mentioned.

One of the SCS hosts said that in Chinese universities there was no single system like

Banner. However, the Ministry of Education was trying to determine how to develop

a Banner-like system. In addition, data mining was being used to guide allocations of

the university budget.

2. Q: What is the status of research on (i) indoor localization, (ii) tracking

stolen vehicles?

A: GPS-based approaches are important, e.g. for locating firemen

and other disaster workers. There are 2 approaches. Ultrawide band gives

high resolution but is very expensive. Peer to peer networks, where

signal strength is a measure of distance, are only accurate to the level

of room location. Use of the latter involves distributed algorithms. Some US

University research was also mentioned in the area of mobile robots that are used as

network relays and keep the network connected in indoor MANETs; when the nodes get

disconnected the robots move to reconnect.

3. Q: What tools are available for semantic analysis, especially with text?

   A: The 2 main approaches are statistical (tagging) and rule-based

   (grammars). Some methods involve training with a text.

4. Q: What are some 'hot topics' in AI from the perspective of delegation

   members?

A. Members of the Delegation gave a variety of answers including:

- Datalink minimization in networks, datalink connections between

two unmanned systems.

- Management of large-scale distributed autonomous systems.

- Human-centered environments; environments with unknown or uncertain

features.

- Interaction between AI and the Web, including transforming

information to knowledge.

- Human-robot interaction. Smart environments (e.g. monitoring),

as in nursing homes.

- Socially intelligent robots, e.g. for work with the elderly.

- Semantic-based queries.

B. University/Industry

1. Q: What are some of the employment opportunities for graduates in AI?

   A: There is a high demand in the financial sector, especially in connection

with data mining. Google is also hiring a lot of graduates, again in connection with data mining.

2. Q: What kinds of companies tend to collaborate with universities on AI-related projects?

A: Members of the Delegation gave a variety of answers including:

- Financial service companies. E.g. American Express uses AI in software that checks which charges may be fraudulent. Car companies have supported research on mobile robotics at Stanford and CMU.

- Aeronautics and aerospace

- The Cork Constraint Computation Centre has collaborated with many companies including Bauch and Lomb (scheduling), Lucent (value chain management), Treemetric (a forestry startup; production management).

- Mercedes Benz has supported research on data mining for more customized service. There has also been support for multi-agent systems for mobile phones. Defense companies, such as Lockheed, support research on robotics.

- Daimler has supported research on autonomous vehicles, the ultimate goal of which is the development of assisted driving (e.g. warning systems).

The visit ended with an exchange of professional cards, gifts and picture taking.