

**INTERIM STATUS REPORT**

**MEDICAL INFORMATICS AND  
TECHNOLOGY APPLICATIONS  
CONSORTIUM**

**NASA Research Partnership Center**

**Cooperative Agreement NCC 8-264**

**Virginia Commonwealth University  
Richmond, VA**

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## EXECUTIVE SUMMARY

This report serves as an interim report on the performance of the Medical Informatics and Technology Applications Consortium (MITAC) in meeting its objective for the period November 1, 2002 – April 30, 2003. The first six months of the 7<sup>th</sup> year of the establishment of the MITAC have been a busy and productive period. During this period, the MITAC has been involved in a number of activities. This report will highlight many of these activities as well as discuss the development of commercial products and services from MITAC activities in the laboratory. This report marks the first formal submission of a report under the new cooperative agreement with NASA MSFC (NCC 8-264).

The MITAC staff remains committed to accomplishing the tasks as they are assigned. It also maintains a highly versatile cadre of telemedicine experts who are prepared to meet NASA's needs and challenges. The MITAC has been working closely with NASA and responds quickly to NASA requests. The MITAC staff has traveled to a number of unique locations throughout the world to further develop test beds for evaluation and validation of telemedicine technologies and share lessons learned. MITAC's efforts in education continue with enhanced learning tools and novel approaches that broaden the capabilities of reaching those students in remote locations.

During the past six months, MITAC has worked closely with academia and industry to pursue common goals. These include development and nurturing of a relationship with industrial entities including TeleVital, Sonosite, AMD Telemedicine, American Telecare, and VitelNet, as well as other governmental entities such as the Virginia Center for Innovative Technology to leverage resources and enhance the telemedicine marketplace. Additionally, MITAC has leveraged the NASA investment through other research grant awards. This peer-reviewed research comes to MITAC from NASA and from DoD's Telemedicine Advanced Technology Research Center (TATRC).

The accomplishments of MITAC at the midpoint of the year are presented herein this report.

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## **INTERIM STATUS REPORT**

### **INTRODUCTION**

This report represents a status of the MITAC's activities from November 1, 2002 – April 30, 2003. It is considered an interim status report. It complements the milestones provided to NASA MSFC in March 2003. This report provides a status on administrative areas (management, interaction with NASA, financial, and organizational); industrial affiliations; projects and test beds; technology initiatives; education and outreach; business development; publications; unique opportunities; and future activities. Many of the MITAC activities can be viewed at the following web site [www.meditac.com](http://www.meditac.com).

### **ADMINISTRATIVE**

#### ***Management***

MITAC's management team remains strong with a focus on providing high quality services, sound management principles, fiscal responsibility and business development. These attributes and the high standards instilled in the staff are vitally important to the success of MITAC.

MITAC's Board of Directors met on April 22, 2003 to review MITAC's activities at midyear and determine any changes in scope or direction. This meeting was conducted via teleconferencing and the web. All materials were well received and the Board was very impressed with MITAC's accomplishment, breadth of knowledge and capabilities. They provided good feedback and highly recommended developing strong partnerships with other governmental entities to share knowledge.

#### ***Interaction with NASA***

MITAC continues to serve as a focal point for NASA with regard to telemedicine. Its assembled expertise maintains awareness and a state of readiness to respond to NASA's needs when it comes to telemedicine.

Effective November 1, 2002, MITAC's Cooperative Agreement, administered by Virginia Commonwealth University (VCU) was changed so that its management would come directly from NASA Marshall Space Flight Center (MSFC) Space Product Development (SPD) Office rather than NASA Johnson Space Center (JSC). The new contracting officer's technical representative (COTR) from MSFC was named as Mr. Joseph Casas.

MITAC provided its annual report to JSC as a deliverable against its original Cooperative Agreement with JSC for the period, Nov 1, 2001 – Oct 31, 2002. Copies were also provided to NASA HQs and to JSC.

MITAC successfully prepared and participated in a site review by Booze, Allen, Hamilton (BAH). BAH was under contract by SPD to conduct a review of all the Commercial Space Centers (CSC). This review took place in February 2003. MITAC

provided an extensive review of its programs and capabilities. The report was reviewed and commented on.

MITAC has worked closely with SPD to continue to refine the role of the CSCs also referred to as Research Partnership Centers (RPCs). This included discussion about the importance and relationship of MITAC's activities to NASA's Strategic Plan. MITAC is poised to work with NASA in exploring space architecture that includes telemedicine. This has permitted MITAC an opportunity to share its capabilities with NASA as an effective approach in meeting several key components of the Office of Biological and Physical Research (OBPR) strategic plan. MITAC has participated in several OBPR-led strategic planning meetings to facilitate and promote the SPD program to OBPR and NASA's overall strategic vision.

MITAC has worked closely with other RPCs or CSCs in pursuing a flight experiment of the HDMAX, a high definition TV camera on board the ISS. This NASA proposed plan to fly an HDTV camera on board the ISS involves several RPCs. MITAC's role will be focused on telemedicine applications with this device. Collaborative activities, such as the preparation of the HDMAX for flight, demonstrate the ability of the RPCs to work closely together in meeting a NASA need.

Aside from contractual obligations to NASA MSFC, MITAC interacts on a regular basis with personnel from NASA HQs and MSFC through the provision of information on MITAC activities as requested by the SPD. MITAC also provides occasional input to NASA HQs for reports and other queries regarding telemedicine.

In FY01, NASA assigned an "earmark" to MITAC. This earmark was for financial support to Columbia University and New York Presbyterian Hospital to work on a device called a VigLens<sup>TM</sup> patient monitor. The funding for this effort was completed during the past 6 months. A complete report, highlighting what has been accomplished, is being prepared on the benefit to NASA regarding this activity.

Mr. Doarn serves on an advisory committee to Imaging Technology Space Center at FAU. MITAC has worked closely with ITSC in the area of ultrasound imaging and the proposed test flight of the HDMAX camera.

Mr. Doarn was reelected as Secretary of the American Telemedicine Association. His term on the executive board will expire in May 2004.

Dr. Merrell and Mr. Doarn continue to serve as senior advisors to the Russian Foundation for Telemedicine.

Dr. Merrell also continues to serve as the chair of the Aerospace Medicine and Occupational Health Advisory Committee and as a member of the NASA Advisory Committee.

## ***Organization***

MITAC has an outstanding team of technical and medical professionals to meet its objectives. The staff is highly motivated and extremely talented. Each member significantly contributes to MITAC in unique ways. Several post-doctoral fellows have joined the staff. These individuals bring a unique perspective to the organization. These individuals remain a member of the team during a one-year period or more. In addition, MITAC has benefited from other faculty member involvement from various Departments of the School of Medicine, Engineering, and Allied Health.

## ***Financial***

This period of performance is the 7<sup>th</sup> year of MITAC's existence and the second annual renewal. The MITAC program plan and budget of \$1,000,00 for the period November 1, 2002 – October 31, 2003 was submitted to NASA in November 2002. To date, MITAC has received \$1,000,000 or 100% of the approved amount. Funding was made in three increments, \$200K, \$300K, and \$500K. The last supplement was made in April 2003. This last supplement was linked to submission of a milestone status at the 6-month interval.

As of this report, the MITAC has leveraged the NASA investment as highlighted in Table 1.

<b>Leverage</b>	<b>Cash</b>	<b>InKind</b>
Tyco-USSC	\$600,000 <sup>1</sup>	
MCV-VCU Dean Contribution	\$250,000 <sup>2</sup>	
VCU Salary Augmentation(s)	\$150,000	
VCU Telemedicine	\$85,000	
VBRP – Personnel Support	\$25,000	
TeleVital		\$20,000
NASA Funded Research - Broderick	\$257,871	
TATRC Grant – Doarn	\$123,782 <sup>3</sup>	
TATRC Grant – Merrell	\$185,096 <sup>3</sup>	
Donated (hardware, software or inkind)		\$100,000
FACR – Indirect Cost Recovery	\$70,000	
	<b>\$1,746,749</b>	<b>\$125,000</b>

1 The Tyco-USSC Effort has been reduced. This was always planned.

2 The Dean of VCU School of Medicine provides MITAC, matching funds of \$250K/year.

3 To be awarded in June 2003. Received verbal approval

**Table 1.** MITAC leverage

This makes the leverage at the interim period 1.9:1.

It is anticipated that additional investment dollars will come to MITAC based on activities in the coming months. This includes the development of new relationships with financial investment, donation of equipment and in kind services and potential royalty streams from licensing of MITAC-developed technology. Additional funding will also come from other grant opportunities.

MITAC has received or will receive other grant dollars from a NASA grant in response to the OBPR NRA in 2001. This funding was made available in early 2003. The title of this peer-reviewed funded research is “ Computer-based Virtual Reality Training in Microgravity”.

The second group of funds is coming from TATRC. TATRC serves as the US Army’s focal point for telemedicine research and development. MITAC has been notified of two new awards. One is entitled “International Telemedicine Support and Review”. The second is entitled “Integrating Technology for Patient Monitoring in a Digital Operating Room”. Both of these activities will be funded in June 2003.

### **INDUSTRIAL AFFILIATIONS**

During the last 6 months, MITAC has explored the development of collaborations with several telemedicine-oriented companies. These companies as well as those that are industrial affiliates are highlighted below.

#### ***American Telecare***

Preliminary discussions were held between MITAC and American Telecare regarding an affiliation. These discussions were held during the American Telemedicine Association’s Advanced Industry Briefing in December 2002. These discussions have been preliminary and have not resulted in anything further at this time.

#### ***AMD Telemedicine***

Preliminary discussions were held between MITAC and AMD Telemedicine regarding an affiliation. These discussions were held during the American Telemedicine Association’s Advanced Industry Briefing in December 2002. These discussions have been preliminary and have not resulted in anything further at this time.

#### ***Computer Motion, Inc. (CMI)***

MITAC continues to work with CMI in exploring telemedicine and unique tools for surgical applications. CMI continues to provide MITAC with support and additional hardware. The relationship continues with collaboration on funding opportunities through response to various grants. The work with CMI continues through the exploration of better methods for supporting telecommunications and surgical science. This has resulted in introduction of several novel tools for education using telecommunications specifically using robotics to enhance and enable physicians to share the open operative field.

#### ***Sonosite***

Preliminary discussions have been held between MITAC and Sonosite regarding an affiliation. An affiliation was being pursued for donated portable ultrasound devices for use in the Ecuador testbed. Although there was tremendous interest in MITAC’s work, Sonosite was limited on what it could bring the affiliation. Therefore, no further effort has been made.

### ***TeleVital***

MITAC continues to work closely with TeleVital in developing web-based software to support telemedicine via the Internet.

### ***Tyco U.S. Surgical***

The relationship with Tyco United States Surgical (USS) has had two components. One has been with the Minimally Invasive Surgery Center (MISC) here at VCU. This effort has been beneficial in continuing to refine the integration of telecommunications in surgical science, adaptive training techniques, and enhancement of educational tools, procedures and methods.

### ***VitelNet***

Preliminary discussions were held between MITAC and VitelNet regarding an affiliation. These discussions were held during the American Telemedicine Association's Advanced Industry Briefing in December 2002. These discussions have been preliminary and have not resulted in anything further at this time.

## **ACADEMIC AFFILIATIONS**

MITAC works closely with a number of academic institutions both nationally and internationally. They include Dartmouth University Hitchcock School of Medicine, Columbia University; Florida Atlantic University (FAU); Moscow State University in Moscow, Russia; the Russian Institute of Surgery Science and Research (ISSR) in Moscow, Russia; Moscow Medical Academy in Moscow, Russia; the Fundeni Clinic in Bucharest, Romania; Faculty of Medicine and Pharmacy of "Ovidius" University of Constanta in Constanta, Romania; University of Craiova School of Medicine and Pharmacy in Craiova, Romania; and the University of Prishtina School of Medicine in Prishtina, Kosova.

## **GOVERNMENT AFFILIATIONS**

MITAC works very closely with a number of government agencies. These include TARTC, the Office for the Advancement of Telehealth, NASA, the Department of State, and NATO.

### ***TATRC***

For several years MITAC has discussed affiliations with TATRC. This burgeoning affiliation was crystallized in May 2003 with the signing of a Memorandum of Agreement (MOA). This MOA or affiliation agreement provides a platform for MITAC and TATRC to work collaboratively in several areas.

These include MITAC involvement in the Operating Room of the Future workshops. These forums were attended by MITAC Director, Dr. Ronald Merrell as an active participant and lead of the subsection on telesurgery. This work has resulted in several publications on the subject.

It has also led to two funding opportunities for MITAC. Several proposals were submitted for consideration, “International Telemedicine Support and Review” and “Integrating Technology for Patient Monitoring in a Digital Operating Room”. Both of these activities will be funded in June 2003. The International proposal will be under the direction of Mr. Doarn. It will focus on working with TATRC to develop a strategic plan for TATRC’s international telemedicine efforts.

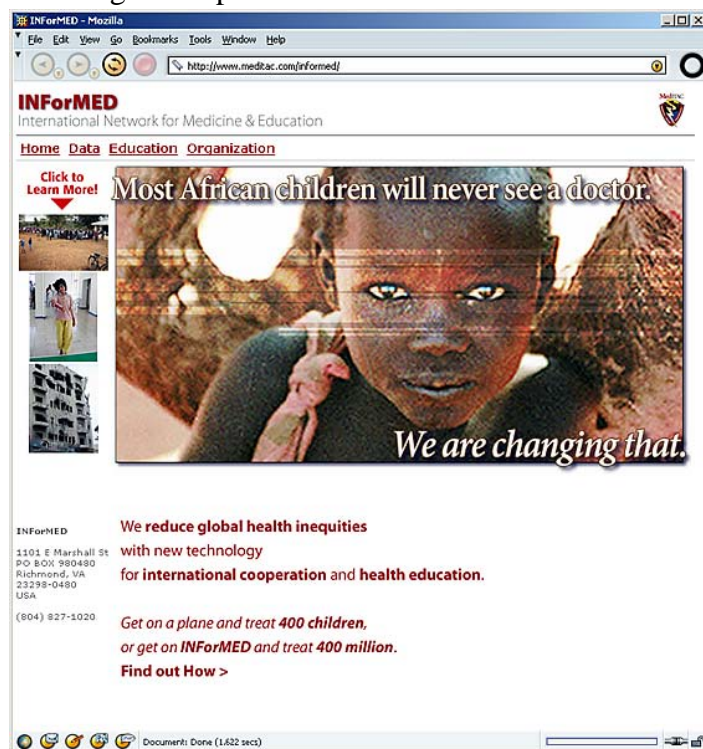
The second activity will be focused on developing an intelligent digital operating room. This effort will be under the direction of Dr. Merrell. In both cases, the MITAC team will be an integral part in accomplishing these tasks.

In April 2003, TATRC officials and two Pakistani physicians visited MITAC. The purpose of the visit was for the Pakistani physicians to undergo a condensed telemedicine course at MITAC. In addition, this provided an opportunity for exploring opportunities for collaborations in telemedicine in Pakistan in the coming months.

### ***Virginia Center for Innovative Technology (CIT)***

CIT awarded MITAC a small ‘seed’ grant to provide a foundation for MITAC to develop a proposal for submission to a funding entity such as the Bill and Melinda Gates Foundation. This work entitled “Development of Telemedicine in the Developing World” continues. One of the key steps in the development of this concept was the establishment of a web site called “INForMED”.

In addition the Gates Foundation, several other philanthropic foundations were approached. Although this effort has not yet resulted in funding from a foundation, the fact that MITAC will be working with TATRC on strategic planning and education in telemedicine internationally, there are several opportunities on the horizon for a network such as INForMED to become a significant portal for telemedicine in the developing world.



### ***US Department of State (DOS)***

In the aftermath of September 11 and the subsequent war in Afghanistan, the State Department's Bureau of Oceans and International Environmental Scientific Affairs (OES) in the Office of Space and Advanced Technology, which interfaces with NASA HQ, asked NASA about telemedicine. NASA HQ's Office of the Chief Medical Officer put the requesting official from OES in contact with MITAC. After several meetings and interaction, MITAC submitted a draft proposal to DOS on a design and implementation strategy for telemedicine applications in postwar Afghanistan. This proposal was considered by some in DOS to be too complicated.

The Director of International Health Programs extended an invitation to visit with he and his staff to learn more about the capabilities. Additionally, MITAC has been involved in discussions with OES regarding an opportunity for implementing telemedicine and distance learning (principally in women's health issues) in remote regions of Afghanistan. The telecommunications to support this effort has been proposed by the Indian Space Research Organization (ISRO) in India. ISRO proposed the deployment of VSAT terminals and adequate bandwidth. This program is still in the planning stages.

OES also requested that MITAC take the lead in planning a telemedicine-centric session for the Space Congress to be held in India in March 2004.

### ***North Atlantic Treaty Organization (NATO)***

As a result of MITAC's telemedicine training of several Romanian physicians affiliated with NASA's East West Space Science Center, MITAC was asked to work with the School of Medicine and Pharmacy in Craiova, Romania as the project director on an infrastructure grant from NATO. This grant would provide funding for telecommunications and information systems infrastructure to support telemedicine in the region. One of the requirements was to have a NATO partner serve as project director. Mr. Doarn served in this capacity. However the grant was not funded.

It did open up a new avenue for additional funding opportunities for telemedicine activities in Eastern Europe and Central Asia. MITAC is exploring several possibilities in this region for funding of test beds for validation of telemedicine capabilities.

### ***Office for the Advancement of Telehealth (OAT)***

OAT coordinates the Federal Joint Working Group on Telemedicine (JWGT). Both OAT and JWGT are directed by Dr. Dena Puskin. Dr. Puskin is also an advisor to the MITAC Board of Directors. Dr. Puskin invited Mr. Doarn to participate as a presenter on NASA and MITAC activities in telemedicine at a JWGT and serve as a reviewer of OAT's grants. The grants submitted to OAT are in the area of telemedicine and rural health. As a reviewer of grants submitted against the OAT request for proposal, Mr. Doarn and therefore MITAC would observe the process of how OAT grants are processed and approved for funding.

## **NASA**

Aside from the Cooperative Agreement between MSFC and VCU, establishing MITAC as a RPC, there are other interactions with NASA. These are highlighted above.

## ***National Institutes for Health (NIH)***

MITAC looks at NIH, the National Library of Medicine and other institutes within NIH as potential funding sources. In addition, the director of the NLM serves as an advisor the MITAC Board of Directors.

## **PROJECTS AND TEST BEDS**

MITAC has evaluated and validated several technological approaches for telemedicine during its existence. Much of this work has been highly regarded by the telemedicine community, especially internationally. This has led to several possibilities and key events. These include working with TATRC on development of a strategic plan for international telemedicine; working with the DOS on telemedicine in Afghanistan; evaluation of technology during the Super Bowl in January 2003; ongoing work in Ecuador; etc.

Test beds are a vital part of what MITAC does. These testbeds provide a unique opportunity to evaluate and validate ideas, concepts, technologies and systems. During the past six months, MITAC has been involved in a number of these testbeds as well as other projects. The following is a status of each of these.

### ***Afghanistan***

As highlighted above, MITAC is working with DOS to develop a telemedicine capability in Afghanistan. The basis for the effort is to initiate a hub and spoke model for telemedicine transmission between key cities in Afghanistan. It would also establish and conduct a “train-the-trainer” program to ensure proper use of deployed telecommunications and telemedicine equipment.

### ***Armenia***

The VCU Health System (VCUHS) contract with the Diagnostica Center in Yerevan, Armenia is still in affect. There has been limited case consultations because of the high cost, so MITAC is exploring a simpler method that will permit a lower consultation fee. The process established to support this contract effort has been modeled for use in other opportunities.

### ***Ecuador***

Currently, MITAC’s testbed in Ecuador continues to make use of the collaboration established with the Clinica Luxemburgo in Macas and the Cinterandes Foundation in Cuenca. Cinterandes Foundation’s humanitarian efforts to bring surgical care to the remote areas of Ecuador, while utilizing these excursions to evaluate telemedicine technologies in extreme conditions has been a valuable activity for MITAC.

MITAC's efforts in Ecuador have not gone without notice. There is increasing interest in broader applications of telemedicine throughout the country. MITAC has secured a donation of laparoscopic surgical equipment for use by the Cinterandes Foundation. In addition, MITAC has worked with Cinterandes to develop a maritime telemedicine capability for mobile health care on the tributaries of the Amazon.

The Clinica Luxemburgo in Macas, Ecuador continues to utilize telemedicine technologies to provide improved general medical care for the underserved people of the Ecuadorian Amazon. Imaging and database contributions from MITAC to the clinic have enabled numerous opportunities for consultation. MITAC has developed a fixed telemedicine workstation at the Clinica Luxemburgo for use in supporting clinical care. MITAC is developing plans for deploying a portable ultrasound capability as well as direct imaging microscopy and colposcopy.

MITAC has worked with trauma surgeons here at VCU and in Ecuador to develop an appropriate educational format to teach better approaches for trauma response thereby enabling better outcomes.

MITAC's efforts in Ecuador have demonstrated and validated unique technologies for application in telemedicine in remote environments. The work of the past 6 months and indeed the past several years have led to marked increase in interest in telemedicine applications as a tool for all of Ecuador and perhaps the region.

### ***Kosovo***

The Kosova Foundation for Medical Development established a Telemedicine Center at the University of Prishtina School of Medicine. One of the technical personnel, Mr. Flamur Bekteshi, Associate Technical Director at the Telemedicine Center of Kosova in Prishtina, visited with MITAC for a month to receive telemedicine training. This training provided a platform for training the trainer. Mr. Bekteshi returned to Kosova equipped with a solid knowledge base that will help him provide training in the area of telemedicine for those individuals of Kosova who have an interest in telemedicine.

### ***Lebanon***

MITAC has had a postdoctoral fellow on the ground at the American University of Beirut (AUB) to explore collaborative activities in telemedicine and distance learning between AUB and MITAC. One of the projects that has been supported is to review how the Internet is used in the Middle East for health care with specific attention on the Internet and Islam.

### ***Moldova***

MITAC's efforts in Moldova have not moved beyond the discussion phase. There were many indications that funding would be coming. However, they never materialized. MITAC has an interest in moving forward but this does not appear to be happening.

## ***Romania***

MITAC is working closely with three different institutions in Romania in mutually beneficial areas of telemedicine and distance learning. These institutions include: (1) the Fundeni Clinical Institute in Bucharest, (2) the University of Medicine and Pharmacy of Craiova in Craiova, and (3) the Faculty of Medicine and Pharmacy of Constanta in Constanta. The purpose of these projects is to improve the delivery of health care in the region and to promote telemedicine and distance learning.

As mentioned earlier, MITAC served as project director on a proposal to NATO for an effort in Craiova. MITAC is also working closely with PIMS on exploring telemedicine opportunities in Romania. MITAC has also initiated a discussion with officials in Constanta about developing and deploying a maritime telemedicine capability for the Danube River Delta. This effort would be similar in concept to that of the design of the river project underdevelopment in Ecuador.

## ***Russia***

MITAC continues to work closely with several organizations in Russia and FSU. The Russian Institute of Surgery Science and Research (ISSR) has been a key focal point during the year. ISSR is also a training clinical base for students from the Moscow Medical Academy (MMA). MITAC is collaborating with ISSR in a mutually beneficial area of telemedicine and distance education. These activities include:

- a. MITAC has provided lectures on Telemedicine and Medical Informatics to fifth year medical students from MMA's Surgery Club with weekly videoconference sessions.
- b. MITAC established a link that permitted interaction between the two distance sites using the computer-controlled robot (AESOP). MITAC's team was able to significantly improve the quality of on-line tutoring in surgery. The students and faculty from ISSR had an opportunity to test the new features and advantages of the new method during the series of surgeries transmitted from VCUHS to ISSR.
- c. As an extension of the idea of the international virtual classroom Russian students are recruited to solve a series of clinical study cases posted on Telecollaboration On Line Database (TOLD), an interactive web-based tool that serves as an electronic medical record and as a clinical consultation platform.

MITAC also continues close collaboration in distance education with Space Biomedical Center for Training and Research (SBCTR), and the Faculty of Fundamental Medicine (FFM) at Moscow State University.

During the past several months, MITAC has signed two affiliation agreements on collaboration in Telemedicine and Distance Education with Kazakhstan National Medical University in Almaaty, Kazakhstan and the Medical Faculty of Kazan State University in Kazan, Tartarstan.

## *Uzbekistan*

The MITAC-developed telemedicine course will be used by OrbitalMed to conduct telemedicine training in Tashkent, Uzbekistan in the summer of 2003. This effort is in concert with Partnerships for Peace Information Management Systems (PIMS).

## **TECHNOLOGY INITIATIVES**

MITAC has developed a number of technologies as a result of its work. These technologies include (1) Operation Lion Heart; (2) Distributed Adaptive Neural Network Implementation for Communications, and (3) ClammyMeter. These technologies are transferred to VCU in accordance with its Intellectual Property policies. In addition, these technologies were validated in key projects. These are highlighted below.

### **Shadow Bowl**

Shadow Bowl was a situational awareness exercise for dealing with potential mass casualty events. MITAC and a select group of research institutions were invited to San Diego to demonstrate their baseline technical capabilities “live” at Super Bowl XXXVII. MITAC made modifications to an existing physiologic monitoring prototype so it could measure the particulate mass of ambient air that might indicate presence of hazardous compounds. By working with a local sensor development company, the system was modified and successfully demonstrated.

The result was a portable, battery-operated device capable of collecting real-time particulate measurements, logging them locally and transmitting the encrypted data over the Internet using standard digital cellular to a web server at VCU. This graphed data was available to the command center at San Diego State University and anyone on the World Wide Web. But what is most interesting about the system is the communication link redundancy. In the event of an emergency such as in New York City on September 11<sup>th</sup>, the cellular services will likely become overburdened and fail. For this reason, a redundant, inexpensive topology was engineered into the unit – Iridium, the Low Earth Orbiting Satellite (LEOS) system.

The plan was to simulate the cellular network “going down” and route the data to Iridium. Ironically, the team was unable to transmit data at game time presumably due to the large increase of voice traffic from the fans in Qualcomm Stadium. The air quality readings from the experimental sensor were then sent successfully via Iridium.

### **Operation Lion Heart**

Lion Heart is a unique client/server application for real-time transport of data from third party sensors. This application is designed to automatically facilitate persistent, redundant communications with a host server over IP networks to deliver real time data for situational analysis using various telecommunication topologies such as Plain Old Telephone Systems (POTS), digital cellular, Low Earth Orbiting Satellites (LEOS), geostationary satellites (GEOS) and even HF packet radio. Data from third party sensors such as air particulate measurement sensors represent the design use.

By integrating affordable, non-terrestrial topologies such as LEOS as communications redundancy, real-time transport of sensor data can still be sent in the event a regional emergency that can cause failure to terrestrial communications. The algorithm can be programmed to switch back to more affordable cellular when the system becomes available.

### **Electronic Patient Assessment System (ePAS) in Emergency Medical Services**

The emergency department (ED) is the primary source of care for persons seeking assistance with chest pain, trauma and many other many other emergency conditions. The goals of this project are to characterize the ED presentation of chest pain patients and trauma cases, and develop an electronic mechanism for collecting triage relevant data, which would be critical for decision rule, to effectively diagnose and treat patients in the selected categories. The acquired data sets will serve to establish accurate and efficient emergency medical services between the patient presenting the symptoms and the remotely located ED physician.

The desired outcome of this research is to create the ability to treat a patient seeking emergency assistance prompted by a patient's 911-assistance call. Paramedics will be able to quickly outfit a patient with chest pain with a sensor suite and transmit data and multimedia to a physician at the ED. This process will enable the responders to evaluate the patient in the field using telemedicine technologies inclusive of transmitting the secure data sets to a central server at the hospital. The application of telemedicine technologies would allow for transmission of secure, accurate patient relevant information to the ED physician for immediate diagnosis and treatment prior to transportation of the patient. Implementation of these technologies would allow for rapid response to the patient needs in time critical situations such as chest pain and trauma events and screen out patients who are not having a serious "medical event" for example. This may eliminate the need for transport, processing and clinical intervention at the hospital. This will reduce costs and allow for more time to process patients who are in fact in dire need.

### ***Sharing the Operative Field***

MITAC worked with Computer Motion's AESOP surgical robot to develop optimal protocols for performing basic open surgical maneuvers without direct viewing of the operating field. The surgeon and assistant observed video monitors, which displayed the image of the surgical field captured by an endoscopic camera instead of the actual surgical field. In order to simulate the operative field, inanimate models of tissue, on which several basic surgical maneuvers were performed, were used. The AESOP robotic arm and an Alpha Virtual Port were used to hold the endoscopic camera in different positions relative to surgeon and the operative table.

It was concluded that at least one of these positions could be translated into the OR. The advantage of integrating video image enhancement over classical open surgery are that the surgical field can be magnified to perform finer maneuvers and that live images of the operative field can be shared with additional clinicians and trainees, with enormous potentials for teaching and mentoring. At the conclusion of this study, discussions have

been carried with Computer Motion for improving the voice recognition software so that our proposed method becomes feasible and safe for the patients when introduced into current practice.

A current experiment consists in using Computer Motion’s Zeus surgical robot to perform cholecystectomies in a pig model. The purpose of the study is to explore the feasibility of using Zeus as an assistant in this type of operations. The attending surgeon sits at the Zeus console, away from the operating table, and he helps the resident, which performs the cholecystectomy. The endoscopic camera is positioned by the attending surgeon’s voice commands, in order to expose the best field of view for the resident. Moreover, the voice activated Hermes’ pointer is also used by the teaching surgeon to show the resident the most important anatomic landmarks and to guide through the course of the operation. During these experiments, we also do videoconferences, to allow the intervention of an expert from outside the operating room, who can play a role in the education process. This is performed with Socrates, another piece of equipment also developed by Computer Motion.

### ***Inventions and Copyrights***

MITAC works closely with the VCU Intellectual Property Foundation (IPF) to transition technology and IP out of the laboratory. Since November 2002 there has been 3 new items transferred to VCU IPF. This is highlighted below.

<b>Invention Disclosure</b>	<b>Description</b>	<b>Status</b>	<b>Submission Date</b>	<b>Inventors/Authors</b>
Lion Heart	A unique client/server application for real-time transport of data from third party sensors	©	Nov 1, 2002	Harnett, Doarn, Zhao
Distributed Adaptive Neural Network Implementation for Communications (DANNI-Com)	A client/server architecture for deploying multiple remote clients across broad, isolated areas where communications is imperative	©	Feb 27, 2003	Harnett, Doarn, Merrell
Clammymeter	A device to detect changes in skin temperature and galvanic skin resistance	©	Feb 5, 2003	Hummel

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### **EDUCATION AND OUTREACH**

Education is a key element of MITAC’s activities. During the past 6 months, MITAC staff pursued several academic opportunities. One of MITAC’s biomedical engineers entered into a Ph.D. program in Biomedical Engineering with a focus on telemedicine. Two other MITAC team graduated with their Executive Master in Business Administration degrees from VCU. MITAC’s Egyptian fellow has completed his preliminary draft of the his Ph.D. thesis.

MITAC team members often participate in a variety of lectures at many different venues including national and international conferences and virtual lectures from VCU to sites in Romania and Russia. These are highlighted below. Mr. Doarn also teaches the undergraduate honors course in Telemedicine at VCU.

Education is a very important aspect of the MITAC's work. MITAC has employed postdoctoral fellows in the laboratory and taught students both in the lab and around the world.

MITAC provided support for a NASA and VCU sponsored activity entitled, "For Inspiration and Recognition of Science and Technology (FIRST)". FIRST is a national robotics competition that provides high school-aged boys and girls an opportunity to express their interest and skills in science and technology. Such events are of critical importance as they serve as a forum for young adults to observe first hand the challenges of science and engineering and more importantly the unlimited possibilities. MITAC is very much involved in education and sharing knowledge.

MITAC is co-sponsoring the Capitol Hill Telehealth & Healthcare Informatics Series. This is the 10th Anniversary Series of educational sessions on behalf of the Steering Committee on Telehealth and Healthcare Informatics. This effort, coordinated by Health Tech Strategies of McLean, VA, provides an opportunity for discipline experts in telemedicine and telehealth to provide a status on programs and leading edge technologies to key decision makers on Capitol Hill.

During 2003, a series of speakers representing a plethora of areas in telemedicine and telehealth will participate in sessions from March through October. These sessions are held during the lunchtime to accommodate many individual schedules. The majority will be held in the Dirksen Senate Office Building or in the U.S. Capitol Building. As a co-sponsor, MITAC will have the opportunity to participate as both speaker and attendee. MITAC will receive a final report from Health Tech Strategies at the conclusion of this series.

### ***Conference Participation***

MITAC personnel participated in a number of seminars and conferences during this reporting period. These include the following:

1. Virginia Biosciences Development Center Luncheon Seminar. Richmond, VA. November 2002.
2. Federal Joint Working Group on Telemedicine. Washington, DC. December 2002.
3. CARTMA, San Juan, Puerto Rico, November 2002.
4. American Telemedicine Association Advance Industry Briefing, Washington, DC. December 2002.
5. Health Tech Strategies Workshop on Remote Health Care Management, San Francisco, CA. November 2002.

6. Shadow Bowl- Super Bowl XXXVII., San Diego, CA, January 2003.
7. Medicine Meets Virtual Reality (MMVR), Newport Beach, CA. January 2003.
8. Capitol Hill Telemedicine and Telehealth Seminars, Washington DC. March 2003.
9. The American Telemedicine Association Scientific Meeting, Orlando, FL, April 2003
10. The 74<sup>th</sup> Annual Scientific Meeting of the Aerospace Medical Association,, San Antonio, TX, May 2003.

## **BUSINESS DEVELOPMENT**

MITAC has initiated discussion with several industrial affiliates in the pursuit of common goals in the area of telemedicine. These include AMD Telemedicine, Sonosite, Terrason, American Telecare, and VitelNet. In the past several months, MITAC has sent letters to several foundations as well. These include the Bill and Melinda Gates Foundations, Rockefeller Foundation, Merck Foundation, Cisco Foundation, AOL Foundation and Case Foundation. As of this date, these relationships are still being pursued.

MITAC spin-off company, OrbitalMed, LLC is moving forward in establishing contracts and pursuing a business strategy to further develop telemedicine services and training..

## **PUBLICATIONS**

MITAC continues to prepare and publish manuscripts in peer-reviewed journals. The following list contains those manuscripts that have been published during this reporting period as well as those that have been accepted and are at press. There are a number of additional manuscripts in work and should be submitted for publication in the coming months. Several MITAC members were invited to write book chapters on various subjects related to telemedicine.

### **Published Manuscripts**

1. Doarn CR, Lavrentyev V, Orlov OI, Grigoriev A, Nicogossian AE, Ferguson EW, Merrell RC. Evolution of telemedicine in Russia: Influences from the space program. A ten-year summary. *Telemed J E-Health* 9(1):103-109. 2003
2. Praba-Egge A, Hummel R, Stewart N, Doarn CR, Merrell RC. Remote telemedicine services by high frequency radio link. *J Clin Eng* 28(1):37-42. 2003
3. Praba-Egge AD, Cone SW, Araim O, Freire IL, Galo PV, Escalante JT, Carrera FM, Chavez MR and Merrell RC. Snakebites in the Rainforests of Ecuador. *World J Surg* 27(2):234-240, 2003.

### **At Press (to be published soon)**

1. Rafiq A, Moore JA, Zhao X, Doarn CR, Merrell RC. Digital video capture and synchronous consultation in open surgery. *Manuscript accepted Annals of Surgery*. 2003.
2. Orlov OI, Levanov VM, Merrell RC, Doarn CR. A federal telemedicine pilot project in the Privolzhsky District, Russia. *Telemed J E-Health*. 9(3): 2003 will be published in September.
3. Merrell RC, Doarn CR. Meeting Summary: A Department of Defense Agenda for Development of the Surgical Suite of Tomorrow. Implications for Telemedicine 9(3): 2003 will be published in September.
4. Cone SW, Gehr L, Hummel R, Doarn CR, Merrell RC. Remote anesthetic monitoring using satellite telecommunications and the Internet. A Case Report. *Manuscript submitted to Anesthesia and Analgesic*. 2002.
5. Rafiq AR, Moore JA, Doarn CR, Merrell RC. Asynchronous confirmation of anatomical landmarks by optical capture in open surgery. *Arch of Surg – At Press*

### **Book Chapters**

1. Merrell RC, Harnett BM, Doarn CR. Telemedicine. Encyclopedia of Biomaterials and Biomedical Engineering. Editors: Wynek GE, Bowlin GL. Marcel Dekker Publisher. *At Press*. 2003.
2. Doarn CR. Telemedicine in Extreme Environments: Analogs for Space Flight. ICT Conference. IOS Press. 2003. *At Press*
3. Nicogossian AE, Lugg DJ, Doarn CR. Civilian Telemedicine in Remote and Extreme Environments. M-Health: Emerging Mobile Health Systems. Editors: Istepanian RH, Laxminarayan S, Pattichis CS. Kluwer Academic/Plenum Publishers. Chapter 26. 2002. *Submitted*.
4. Doarn CR, Nicogossian AE, Merrell RC. Telematic Support for Disaster Situation. M-Health: Emerging Mobile Health Systems. Editors: Istepanian RH, Laxminarayan S, Pattichis CS. Kluwer Academic/Plenum Publishers. Chapter 27. 2003. *Submitted*.
5. Doarn CR. Using new tools to create new databases. Evidence-based medicine: The contribution of telemedicine. Telemedicine and Telehealth in Developing Countries. The First Balkan Telemedicine Seminar. 2003 IOS Press. *Submitted*.
6. Justis D, Doarn CR, Merrell RC. Creating a Distributed Network for Successful Implementation of a Rural Telemedicine Program. Managing People in Telemedicine and E-Health: A Global Perspective. Editors. David Bangert and Robert Doktor. 2003. *Accepted*.

7. Rafiq A, Merrell RC. Socrates: Telementoring for Telerobotics. Primer for Robotic and Telerobotic Surgery. Editors. Garth H. Ballantyne. Lippincott Williams & Wilkins. 2003. In preparation.

## **FUTURE PLANS**

MITAC will continue to maintain its role as a lead center of excellence in telemedicine through continued growth and maturity. The focus of the remaining six months for the MITAC is to continue with its test bed, continue to develop relationships with industry and support NASA's needs as required, and continue to pursue other funding opportunities that can enhance the overall enterprise.

MITAC technical capabilities will continue to mature, churning out new ideas and intellectual property. MITAC will also work closely with NASA's OBPR as it finalizes its strategic planning; input and participation in the space architecture; the preparation of the telemedicine component of the HDMAX. The rate of publications will continue as several manuscripts, currently in the pipeline, will be published as additional research is submitted to peer reviewed journals for publication. MITAC's education efforts will continue as new postdoctoral fellows transition into the laboratory in July 2003. In addition, the MITAC has the opportunity to work with several medical students during their summer hiatus.

The development and establishment of new partnerships will continue with organizations and academics institutions within the US and abroad. The future looks bright and MITAC is excited about its upcoming opportunities. MITAC will work with other organizations to leverage technology and innovation is further promulgating telemedicine.

## **Future Meetings / Activities**

- Although MITAC participates in several meetings both planned and unplanned (those that come up on short notice), the following are the most important.
- Field research – Ecuador, June 2003
- Surgical Education – Azerbaijan. June 2003 (Sponsor travel support covered)
- ATA Meeting on Home Health Care and Remote Monitoring – Ft. Lauderdale, FL. September 2003
- International Society for Telemedicine (IsFT) – Tromso, Norway. September 2003.