EVENT PROGRAM

UPDATED 8/15/03

This is the *Event Program* for BioE / Biotech 2003, which consists of the updated schedule and abstracts.

With speaker permission, we publish presentations as streaming audio files on the event Web page. This allows the widest possible audience to learn from BioE / Biotech presentations.

TUESDAY JUNE 17TH	
SESSION: OVERVIEWS	
Mueller, NASA JSC - Futron	Welcome and Approaches to Partnering
Lundquist, NASA JSC - Biological Systems	NASA's Cellular Biotechnology Program
*Hines, NASA Ames	Advanced Technologies for Space Biology and Medical Research: Technologies and Implementation Methodologies *Talk cancelled; slides will be available in the Presentation Archive
Break for networking and discussion	
Muratore, NASA JSC - Engineering	Biotechnology Facility for the International Space Station
Ambrose, NASA JSC - Robotics	Dexterous Robotics for Telescience
Lunch	
SESSION: TECHNOLOGY NEEDS AND CHALLENGES	
Muntz, UCLA CCMISE	From Cell to Galaxy: Cell Mimetic Technology for Enabling Multi-scale BioNEMs
Jeevarajan, NASA JSC - Biological Systems	Technologies for Continuous Mammalian Cell Culture Monitoring and Control in Bioreactors
Break for networking and discussion	
Simon, Center for Emerging Technologies	Partnering with Early Stage Biotech/Medical Device Companies: How Innovation and Creativity Helps
Loftus, NASA Ames / Stanford	Ophthalmological Applications of Carbon Nanotube Nanotechnology
Bateman, Clemson - Bioengineering	Space Flight as a Biomedical Test-Bed for Osteoporosis
Break for networking and discussion	
Fink, Jet Propulsion Laboratory / Caltech	Eye Sensors and Vision Tests in Space

WEDNESDAY JUNE 18TH	
PARALLEL SESSION: SOLUTIONS I	
Jackman, JHU / Applied Physics Lab	Non-Invasive Detection of Infection
Stilwell, NASA JSC – Techn. Integration	Bioastronautics Technology Needs
Rapchak, Leap of Faith Technologies	Immun.com: Web-based Immunization Registry with Patient Portal for Record Access
Break for networking and discussion	
Kulkarni, U. Texas Health Sciences Center - Houston	Nutritional Immunomodulation as Emerging Science & Technology for Space Travel
Kramer, UTMB - Anesthesiology	Resuscitation Systems for Medical Emergencies
Lunch	
Charles, NASA JSC	Medical Aspects of Possible Future Space Mission Scenarios
Schlegel, Arenare, Kulecz, & Greco, NASA JSC, Wyle, Arkansas Tech U.	The Electrocardiograph of the 21st Century – Enabling It Together
Break for networking and discussion	
Betenbaugh, Johns Hopkins University	Cell Engineering Strategies to Inhibit Cell Death in Mammalian Cultures
Greisler, Loyola University of Chicago	Induction of Endothelialization of Cardiovascular Tissues & Devices
Bradley, Arryx, Inc.	Application of Massively Parallel Optical Trapping Implemented with Diffractive Optics for Control & Assembly of Microscopic Systems…
Brief Closing	
PARALLEL SESSION: SOLUTIONS II	
Gucwa, Technology Management Associates	Why Partner with Industry?
Syroid, University of Utah / MedVis	Graphics Displays to Support Treatment during Medical Emergencies
Moebes, NASA JSC - SAIC	Applications of Cross-Correlations to Myocardial Ischemia Detection
Ansari, NASA Glenn	Early Detection of Cataracts & Possible Treatment Using Dynamic Light Scattering
	Head-Mounted Monitoring System for Ocular Blood Flow & Glucose Sensing
Wheeler, NASA Ames	Bioelectric Interfaces for Human-Computer Interaction
Matthews, Quasar	Development of Through-Clothing Bioelectric Sensors
Parallel session, Solutions II, ends	

ABSTRACTS

Abstracts are listed in alphabetical order by the speaker's last name. Where available, Web links to the organization or project are provided.

Dr. Robert Ambrose, NASA Johnson Space Center - Engineering and Robotics

Dexterous Robotics for Telescience: With limited hands available for the foreseeable future, science missions must engineer their experiments for reduced human interaction. NASA's advances in dexterous robotics may provide a new solution, with machines like Robonaut able to work with small tools and materials that were designed for human hands. New capabilities in the Robonaut system will be presented to introduce new options for science mission designers.

Dr. Rafat Ansari, NASA Glenn Research Center

(1) *Early Detection of Cataracts and Possible Treatment Using Dynamic Light Scattering:* Cataract development is a risk factor for astronauts. Dynamic light scattering (DLS) is shown to be three orders of magnitude more sensitive in its early detection over the current methods. A compact DLS device is used in the trials of pantethine as a potential anti-cataract agent.

(2) *Head-Mounted Monitoring System for Ocular Blood Flow and Glucose Sensing:* A non-invasive compact head-mounted goggles-like device is being developed to monitor health indices through the ocular tissues. Seven different technologies are being integrated into this device to characterize fluids and tissues at the molecular level. Results on the retinal blood flow in zero gravity will be presented. Preliminary data on glucose sensing of a prototype laboratory sensor will also be presented.

Dr. Ted Bateman, Clemson University - Bioengineering

Spaceflight as a Biomedical Test-Bed for Osteoporosis: Results from the CBTM-01 Payload on STS-108 and Its Examination of Osteoprotegerin as a Countermeasure: The Commercial Biomedical Testing Module (CBTM-01) payload on STS-108 represents the first examination of the skeletal system of space-flown mice. This talk will present the technical and hardware challenges associated with getting mice approved for flight. The potential for microgravity as a biomedical test bed for human disorders such as osteoporosis will be demonstrated. Data demonstrating the efficacy of osteoprotegerin (OPG), a protein-based pharmaceutical in development by Amgen Inc., to mitigate the bone loss in this extreme environment will be briefly discussed. The talk will conclude with the challenges associated with developing the hardware to perform longer-duration studies on ISS.

Dr. Michael Betenbaugh, Johns Hopkins University - Chemical Engineering

Methods to Prevent Programmed Cell Death in Animal Cell Culture: We are examining ways to maintain cell viability through manipulation of the programmed cell death cascade. We are examining the use of natural apoptosis inhibitors as well as inhibitors that have been engineered for improved activity or reduced degradation. These methods may be useful for examining ways for organisms to increase survival under different stress conditions.

Dr. Kenneth Bradley, Arryx, Incorporated

Application of Massively Parallel Optical Trapping Implemented with Diffractive Optics for Control and Assembly of Microscopic Systems Including Both Artificial Tissue and Advanced Biological Detectors: Arryx, Inc. is commercializing Holographic Optical Trapping technology originally developed at the University of Chicago. This technology can control systems composed of material in the many tens of microns size range down to the nanometer scale. The basis of the technology, current applications to the biological systems and future application to areas such as artificial tissue will be discussed.

Dr. John Charles, NASA JSC Program Integration and Critical Path

Medical Aspects of Possible Future Space Mission Scenarios: Recent long-range planning for exploration-class missions has emphasized the need for anticipating the medical and human factors aspects of such expeditions. Details of mission architecture are still under study, but a typical Mars design reference mission comprises a six-month transit from Earth to Mars, eighteen months in residence on Mars, and a six-month transit back to Earth. Physiological stresses will come from environmental factors such as prolonged exposure to radiation, weightlessness en route to Mars and then back to Earth, and low gravity and a toxic atmosphere while on Mars. Psychological stressors will include remoteness from Earth, confinement, and potential interpersonal conflicts, all complicated by circadian alterations. Medical risks including trauma must be considered. The role of such risk-modifying influences as artificial gravity and improved propulsion technologies to shorten round-trip time will also be reviewed. Results of planning for assuring human health and performance will be presented.

Dr. Wolfgang Fink, Jet Propulsion Laboratory / Caltech

Eye Sensors and Vision Tests (in Space) such as Tests for Visual Fields and Sensors for Intraocular and Intracranial Hypertension: Vision is the primary sense used by astronauts in space and people on Earth. The 3D computer-automated threshold Amsler grid test (Fink/Sadun) quantifies visual field loss (http://www.wfbabcom5.com/wf335.htm) and is the core element of an autonomous visual field test and diagnosis system in space and on Earth. Further, the wireless intraocular pressure sensor (WIPS) enables monitoring of intraocular hypertension and assists glaucoma therapy.

Ms. Joanne Gucwa, Technology Management Associates

Why Partner with Industry?: Strategic Partnering = Strategic Synergy: increased "Rate of Return on Research" (labs get corporate fund and industry gets faster results), resulting in improved allocation of resources. Selected examples of technologies and systems offering collaboration range from homeland security and disaster recovery to bioengineering and platform IT tools.

Dr. Howard Greisler, Loyola University of Chicago

Induction of Endothelialization of Cardiovascular Tissues and Devices: The efficacy of current cardiovascular therapeutic modalities is limited primarily by restenosis. The induction of in vivo angiogenic processes may yield surface endothelialization, inhibit restenosis and allow use of tissue-engineered vessels without untoward non-autologous endothelial cell-induced immunologic reactions. Local delivery of naturally occurring and mutant growth factors to vascular grafts and vessel walls will be discussed.

**Mr. John Hines, NASA Ames Research Center - Astrobionics*

Advanced Technologies for Space Biology and Medical Research: Technologies and Implementation Methodologies. *Presentation cancelled, but slides will be available in the Presentation Archive

Dr. Joany Jackman, Johns Hopkins University / Applied Physics Laboratory

Non-Invasive Detection of Infection: JHU/APL with DARPA support is developing a method for non-invasive detection of infection using biomarkers, which appear in exhaled breath. While volatile markers have been the subject of much research, JHUAPL is focusing on the non-volatile protein and lipids secreted in the lung in response to infection. These molecules which become entrained in water vapor in expired breath are the subject of analysis. For the past three years, JHU APL has been developing a system to rapidly detect infection.

Mr. Antony Jeevarajan, NASA JSC - Biological Systems Office

Technologies for Continuous Mammalian Cell Culture Monitoring and Control in Bioreactors: The mammalian cell lines can optimally be grown in a bioreactors by monitoring and controlling the essential metabolic parameters. In this presentation results obtained from pH, oxygen, carbon dioxide and glucose sensors while monitoring a mammalian cell culture will be presented.

Dr. George Kramer, University of Texas Medical Branch - Anesthesiology

Resuscitation Systems for Medical Emergencies: Astronauts and interplanetary space travelers will have limed access to standard diagnostic equipment and means for prompt and effective delivery of drugs and fluids for medical emergencies. New technologies are being developed that combine sensors, diagnostic algorithms, and incorporate drug and fluid delivery approaches that can be applied by non-medical personnel. Such 'Resuscitation Systems' may provide the most efficient means to treat medical emergencies in remote environments.

Dr. Anil Kulkarni, University of Texas Health Sciences Center - Houston

Nutritional Immunomodulation as Emerging Science and Technology for Space Travel: Space travel and its microgravity environment decreases immune system function. We will present our innovative approach to prevent such immune system dysfunction using ground-based microgravity analogs, both in animal and cell culture models. Our studies document that supplemental nucleotides and their formulated mixtures maintain and restore immune function as indicated by activation of cell-mediated immune system. Functional, cellular, and molecular mechanisms will be presented.

Dr. David Loftus, NASA Ames Research Center / Stanford University

Ophthalmological Applications of Carbon Nanotube Nanotechnology: In collaboration with investigators at Stanford University, the Center for Nanotechnology at Ames is involved in the development of a silicon chip with an array of electrically addressable carbon nanotube towers, designed to be implanted into the retina, as a novel treatment for retinal degenerative disorders. A second project involves the use of the nanomaterial "Bucky Paper" as a carrier to facilitate transplantation of retinal pigment epithelial cells, as a potential treatment for macular degeneration, the number one cause of blindness in the elderly.

Dr. Charles M. Lundquist, NASA JSC - Biological Systems Office

NASA's Cellular Biotechnology Program: NASA's Cellular Biotechnology Program encompasses activities in engineering tissue for research; growing cells and tissue for disease studies; using microorganisms and cell design to create new drugs and drug delivery methods; exploring how gravity affects cell growth and gene expression; and providing the facilities and advanced technologies necessary to conduct biotechnology research.

Dr. Robert Matthews, QUASAR

Development of Through-Clothing Bioelectric Sensors: Researchers at QUASAR have developed a new class of bioelectric sensor that can measure various bioelectric signals at the microV level without direct electrical contact to the skin. Clinical quality ECG signals have been measured through normal cotton shirts during a 40-person clinical trial at Walter Reed Army Research Center. Sensors have also been developed to measure EOG and EEG signals without any scalp preparation or electrical contact with the skin.

Dr. Travis Moebes, SAIC

Applications of Cross-Correlations to Myocardial Ischemia Detection: Multi-channel Times Series Analysis may used to predict Myocardial Ischemia and other heart related problems especially related to women. This technology, first developed by Norbert Wiener in the early 1960's, is applied to today using a VBA Excel Engineering spreadsheet. This concept could be incorporated in larger computer systems. The data comes from previous Myocardial Ischemia and open-heart studies conducted at Baylor College of Medicine.

Ms. Alyssa Mueller, NASA JSC - Technology Integration / Futron Corporation

Welcome and Approaches to Partnering: Large government investments in technology development result in many ready-to-use, licensable technologies, but significant benefits often come from long-term collaborations with government innovators and scientists. Collaborative efforts, using Space Act Agreements and other techniques, can provide solid protection for intellectual property rights of industry partners while benefiting both government and industry. This brief presentation will cover how to find, start, and nurture such relationships and will give examples of some successes and pitfalls in these collaborations.

Dr. Alice Muntz, UCLA Cell Mimetic Space Exploration (CMISE) Institute

From Cell to Galaxy: Cell Mimetic Technology for Enabling Multi-Scale BioNEMs: Natural systems are a complex composition of many subsystems interacting at a multitude of levels. CMISE is a NASA-funded University Research, Engineering, and Technology Institute (URETI) at University of California at Los Angeles (UCLA). CMISE faculties have pioneered Cell Mimetic Technology consisting of nano-scale sensors, actuators, and energy sources for sensing, control, and integration of complex multilevel natural and artificial systems. We will mimic the adaptive ability of natural cells to structure themselves precisely into ever more complex systems. CMISE will build intelligent hybrid systems of molecular machines to monitor and control biological and artificial subsystems.

Mr. John Muratore, NASA JSC - Engineering

International Space Station Biotechnology Facility (BTF) Overview: abstract not available

Ms. Barbara Rapchak, Leap of Faith Technologies

Immun.Com: Web-Based Immunization Registry with Patient Portal for Record Access: Immun.com is an Internet based immunization registry and Website that offers both patient and provider interfaces, reinforcing a continuum of care. It is HIPAA compliant, and has HL-7 and XML import and export capability. Efficacy was validated in a randomized trial among parents, and functionality was validated by the Illinois Department of Public Health.

Mr. William B. Simon, Center for Emerging Technologies

Partnering with Early Stage Biotech / Medical Device Companies: How Innovation and Creativity Helps: Facts about how and why we encourage partnering with our early stage biotechnology and medical device related companies are presented. Brief information about our current clients and their needs will show the wide variety of the science and the expected benefits.

Dr. Todd Schlegel, NASA JSC; Dr. Brian Arenare, NASA JSC - Occupational Health Clinic; Dr. Walter Kulecz, Wyle Laboratories; Dr. E.C. Greco, Arkansas Tech University

The Electrocardiograph of the 21st Century – Enabling it Together: Our laboratory at NASA-JSC has recently developed an advanced electrocardiograph (ECG) device that allows the clinician, for the first time, to view and continuously monitor, in real time, changes in the high frequency (HF) signals present within the QRS portion of the 12-lead ECG. These HF signals carry clinically important information but are not available using currently manufactured conventional ECG equipment. To enable acquisition and processing of the HF signals, our technology combines a

commercially-available PC ECG platform, customized for HF analysis, with proprietary software. Initial clinical data suggest that our HF QRS technique is useful not only for the enhanced, non-invasive detection of myocardial ischemia and infarction (i.e., compared to conventional ECG), but also for the non-invasive detection of both coronary artery disease and cardiomyopathy. Perhaps more importantly for the present conference, we have designed our 12-lead PC ECG platform such that its internal code for software communications is "open-interface", meaning that we are also able to accommodate the promising software-based diagnostic ECG techniques of other investigators into our platform. For example, in addition to our own HF QRS ECG application, we have also integrated several heart rate variability applications and a beat-to-beat QT interval variability application - all of which have value for predicting incipient cardiac arrhythmias. Although most of these other applications belong to outside investigators, we have assisted each outside investigator group with grafting his/her software onto our common ECG platform such that all of the different advanced software applications can be run and monitored at the same time, and in real time. We plan to continue our "open interface" policy for the foreseeable future, encouraging collaborations with other scientists and technologists who are also able to bring their own promising ECG software applications to our attention. During our presentation, the PC ECG device itself as well as some of the various "piggybacking" advanced software applications will be demonstrated.

Mr. Don Stilwell, NASA JSC - Technology Integration

NASA Human Life Sciences Technology Needs: NASA continuously plans for alternative futures in which explorers journey where humanity has yet to tread. Approximately every two years (or less frequently if we can afford to), the Advanced Technology Integration Group has polled NASA's life sciences personnel about technology needs and priorities in relation to these slowly evolving mission plans; for 2003, we developed a comprehensive technology needs survey to compile and assess current technology needs. Although the assessment is still in work and not all responses are in yet, we will preview some of the highest priority technology needs for the International Space Station (ISS), our current mission. This is the first time these survey results will be presented, albeit covering only a tiny fraction of the data in preliminary form.

Mr. Noah Syroid, University of Utah / MedVis

Graphic Displays to Support Treatment during Medical Emergencies: We developed a computerized graphical display for performing CPR procedures on the international space station. Volunteers using the display removed an airway obstruction and stabilized the patient in 10.9 minutes compared to 13.8 minutes for those who used the current NASA paper protocol.

Dr. Kevin Wheeler, NASA Ames Research Center, Computational Sciences Division

Bioelectric Interfaces for Human-Computer Interaction: Bioelectric interfaces include the use of electromyograms (EMG) for gesture based interaction as well as electroencephalograms (EEG) for brain computer interfaces. We will describe our work in the development of these technologies as well as a software framework enabling all of the streaming analysis.