SYMPOSIUM REPORT

The Human Operations Web page, including streaming audio presentations, is now available at http://advtech.jsc.nasa.gov/events_of_interest.shtm

HUMAN OPERATIONS 2001

Focusing on the technologies of greatest value to human operations during an emergency, be it in an urban community, the military theater, or the vast reaches of space

Overview

Human Operations was conceived to explore the most difficult problems facing human operations and to ensure a lively discussion on the best technology solutions. We began by outlining a specific operational scenario—in which comparatively untrained crews must manage a life-threatening emergency with scarce resources—and explored the role of intelligent technologies in such a scenario. This approach capitalized on past meetings about wireless technologies, telemedicine, medical operations, and smart systems, yet did not duplicate those meetings.

Human Operations should not be considered the typical professional meeting, in which presenters discuss the technical and scientific details of their work. Throughout the planning and execution, we carefully differentiated it from large-scale conferences or meetings. Instead, the symposium emphasized technology-oriented solutions. By virtue of the invitation-only audience and the narrowly focused topic, Human Operations served a vital need for education and collaboration. Participant feedback (addressed later in this report) indicates that this new, "minimalist" approach was very effective.

As a result of Human Operations, we found that basic assumptions about an emergency scenario are shared by diverse interests in the larger biomedical community. We heard from researchers, developers, engineers, and clinicians representing NASA, the military, and academia; in doing so, we began to explore the common needs of this new community and to encourage collaboration for reaching the best technology solutions. Thus, Human Operations brought new emphasis to a specific operational challenge and to the intelligent technological solutions possible.

*We must **continue** to focus on the intelligent technologies that support crews as they manage life-threatening emergencies.*

Sessions

Human Operations featured four sessions that provided a thorough introduction to academic, military, and NASA perspectives. In addition to building a foundation of common knowledge, we also learned about some of the greatest needs and best solutions in intelligent hardware and software. The symposium talks covered an impressive range of topics, from lessons learned in hospital management during Tropical Storm Allison, to the development of an intelligent medical checklist using a wrist-worn interface.

In lieu of cataloging each presentation in this report, we recorded as many of them as possible and are publishing them online as streaming audio files. Presentations that could not be recorded are also published as PowerPoint slides on the Human Operations Web page (http://advtech.jsc.nasa.gov/events_of_interest.shtm). In this way, the presentations reach the widest possible audience, including participants who want to review the talks and potential collaborators who need a thorough introduction to this topic. Because the process of converting and approving the streaming audio is somewhat lengthy, we are publishing the talks as we receive them.

Please return to the Human Operations page often as we will continue to publish presentations.

Evaluation and Assessment

To improve future events and to measure the value of Human Operations, we collected feedback forms during and after the symposium. Of 85 registered participants, 40 completed feedback forms, yielding an excellent response rate of 46%. By contrast, feedback on past events was much lower, around 25%. Over half of the respondents also took the time to write (sometimes extensive) comments that will further guide future symposia and events. Due to the large file size of the feedback data, it is not included in this report but is available by request; an abbreviated version is available online at http://advtech.jsc.nasa.gov/humanOps.shtm under the Feedback section.

Summary: 46% responses or 40 of 85 registered participants

Question 1: How did you learn about this meeting?

- *49% Email*
- *24% Colleague*
- *20% Other*
- *07% Another meeting*

Summary: Email and "word-of-mouth" are effective means of identifying and inviting participants for this type of small-scale meeting.

Question 2: What are your objectives for attending?

- *28% Learn*
- *25% Make new contacts*
- *24% Interact with peers*
- *19% Present work*
- *04% Other*

Summary: Respondent objectives and symposium objectives are basically the same, meaning that the objectives and purpose were clearly defined in symposium announcements.

Question 3: Overall, how would you rate this meeting?

- *46% Excellent*
- *44% Very good*
- *10% Average*
- *00% Below average*

Summary: Average of all responses is 3.4 / 4.

Question 4: How would you rate the content of this meeting?

- *56% Very good*
- *36% Excellent*
- *08% Average*
- *00% Below average*

Summary: Average of all responses is 3.3 / 4.

Question 5: What part of the meeting was most valuable?

- *52% Presentations*
- *22% Networking*
- *20% Technology demonstration(s)*
- *04% Breakout sessions*
- *02% Other*

Summary: A majority of the respondents found the presentations to be most valuable, so the amount of time devoted to presentations was appropriate. The responses indicate that the event met its objectives, since networking was the second most common response.

Question 6: What collaborations or partnerships may result from this event?

- *48% New ones*
- *44% Both*
- *08% None*
- *00% Old ones*

Summary: Since 92% of the responses indicated that old and new collaborations might result, this symposium was a very effective means for encouraging collaboration. Equally important, a significant number of respondents indicated that this symposium provided the opportunity for new collaborations; this shows that Human Operations successfully recruited a new community of participants and did not consist of the so-called "usual suspects" – a group of colleagues who consistently attend the same events.

Question 7: What sector of the community are you affiliated with?

- *38% NASA Center*
- *23% Military*
- *21% Academic*
- *10% Commercial*
- *08% Other*

Summary: The composition of the respondents matches that of all participants, indicating that these responses are an accurate sample of all participants. Equally important, the balance between NASA, military, and academic respondents shows that we successfully recruited all segments of the community.

Discussion Notes

In lieu of convening formal breakout sessions, 20 or so participants gathered on Thursday morning to consider a few points for general discussion.

- *What are the most critical needs that can be reasonably met within the next 2 years, given the current rate of technology development?*
- *What are the most critical needs that can be reasonably met within the next 5 years, given the current rate of technology development?*
- *What technology solutions are receiving the most attention? What SHOULD receive the most attention?*
- *What technology solutions are receiving the least attention? What SHOULD receive less attention, given limited budgets and current rate of development?*
- *Identify emerging technologies that may influence emergency operations in any environment*
- *What current technology "trend" has the greatest potential influence on emergency operations?*
- *Identify near-term (1 year) opportunities for collaboration*

- *What are the greatest barriers to collaboration between interested parties?*
- *Which of these barriers can be resolved or minimized? How?*

While ensuing discussion did not address these particular questions, it was a valuable forum for better understanding the needs of emergency operations (technological or otherwise). The following is a brief record of this discussion.

Most of the discussion focused on the critical resource limitations that may be minimized through some combination of intelligent technologies, training, and ground support. In particular, some participants again voiced the need for definitive descriptions of current capabilities, on-orbit specifications for existing technologies, and requirements for new technologies. Some of the best online resources are listed in the next section of this report.

Communication and telemetry bandwidth were the particular focus of the discussion on resource limitations:

- *Availability is both operation- and scenario-dependent, such that all available bandwidth would be freed during an emergency*
- *The maximum rates for the Ku-band (voice communication) are 6 megabits/sec downlink and 3-4 megabits/sec uplink; higher rates for transmission are in work*
- *No bandwidth requirements can be defined for medical operations, possibly because the rates are untenably low*
- *Due to satellite limitations and Station geometry, the Ku-band will be available approximately 50% of the time during nominal operations*
- *The above percentage does not mean 45 continuous minutes of loss of signal (LOS), but instead that on-orbit time will be marked by regular 5 to 10-minute intervals when no communication is possible; the maximum time for a single LOS is estimated to be 25 minutes*

In addition, participants described other areas of great need or particular challenge:

- *Medical hardware for ISS is based on an outdated paradigm, which assumes that a crew return vehicle is available to evacuate an injured crewmember; without the crew return vehicle (CRV) for the foreseeable future, the paradigm and necessary technologies must shift to on-orbit stabilization and medic-level treatment*
- *Without a CRV, stabilization and treatment of an injured crewmember must be extended from a few hours to several days*
- *Time for training crew is one of the single greatest needs*
- *Software becomes increasingly important for longer-duration missions because hardware cannot be resupplied*

More Information

Many participants voiced a need for more specific technical information, especially if they are involved in technology development. The following resources and points of information are offered to help meet that need.

- ***Special Operations Computer-Assisted Medical Reference System (SOCAMRS)***: a set of four CDs containing approximately 3,660 items (mostly full text) in 87 different areas of interest to Special Operations medical personnel, including combat casualty management, diving medicine, altitude sickness, nutrition and hydration, supplements, aviation medicine, and NBC casualties. [not available online]
- *Operational Medicine and Human Weapon Systems Requirements*: for those would like to offer a potential solution for the stated requirement, please contact Lt Richard Scott (email Richard.Scott@brooks.af.mil or phone 210-536-3455 / DSN 240) for a more thorough description. [listed at the end of this report and posted on the Human Operations Web page: http://advtech.jsc.nasa.gov/downloads/Tally_final.PDF]
- *Medical Informatics and Telemedicine for Space Flight*: report from a detailed planning workshop on NASA's future medical informatics and telemedicine efforts that was held November 1999. [posted on the Human Operations Web page: http://advtech.jsc.nasa.gov/downloads/Workshop Report.pdf]

The following Web addresses, which represent only some of the many online resources available, are offered as well.

General Information about NASA	
Office of Biological and Physical Research	http://spaceresearch.nasa.gov/
Human Spaceflight	spaceflight.nasa.gov/index-n.html
Office of the Chief Technologist	http://nasatechnology.nasa.gov/chieftechnologist/
Technology-Focused Sites	
JSC Advanced Technology Integration home page	http://advtech.jsc.nasa.gov/
Critical Path Roadmap home page	http://criticalpath.jsc.nasa.gov/
JSC Office of Technology Transfer and Commercialization	http://technology.jsc.nasa.gov/
NASA Technology Portal	http://nasatechnology.nasa.gov/index.cfm
MedWeb: US AF Medical Services Requirements	https://www.afms.mil/medweb [note limited access for .edu/.com]
Medical Informatics & Technology Applications Consortium	http://www.meditac.com/
US Army Telemedicine & Advanced Technology Research Center	http://www.tatrc.org/
Center for Total Access: medical informatics research and development	http://cta_site.cta.ha.osd.mil/flash/index.html
Biomedical Research and Medical Operations	
JSC Space and Life Sciences Directorate	http://www.jsc.nasa.gov/sa/
JSC Advanced Life Support	http://advlifesupport.jsc.nasa.gov
Human Research Facility: Space Station facility for biomedical research, currently operational	http://hrf.jsc.nasa.gov/
National Space Biomedical Research Institute: consortium of academic institutions working on countermeasure research and development	http://www.nsbri.org/
ISS Medical Checklist: examples and extracts from medical operations procedures for the space station	http://www.spaceref.com/iss/medical.ops.html [**not** a NASA site]
US Air Force Flight Surgeon's Guide (being updated)	http://wwwsam.brooks.af.mil/af/files/fsguide/HTML/00_Index.html
Spaceline: space-related biomedical research, includes list of recently published articles	http://spaceline.usuhs.mil
Life Sciences Task Books: NASA-funded research 1995-2001	http://research.hq.nasa.gov/taskbook.cfm
NASA Research Opportunities	
All NASA Research opportunities	http://www.nasa.gov/research.html
Biological and Physical Research opportunities only	http://research.hq.nasa.gov/code_u/code_u.cfm
Small Business Innovation Research & Small Business Technology Transfer Programs	sbir.gsfc.nasa.gov
Helpful references for understanding NASA research	http://research.hq.nasa.gov/GenInform.cfm
NASA Acquisition Internet Site: procurement announcements	http://procurement.nasa.gov/

Air Force Medical Service Operational Medicine Requirements by Area
Rank Ordered within Operational Areas

BD 1: Biologic agent identification
BD 2: Provider/patient personal protection

CCC 1: Improved resuscitation technologies
CCC 2. Deployable oxygen systems
CCC 3: Field medical monitoring equipment
CCC 4: Advanced aeromedical evacuation equipment
CCC 5: Remote patient monitor system
CCC 6: Point of injury monitoring
CCC 7: Improved modeling tools
CCC 8: Advanced medical communications

CD 1: Patient decontamination
CD 2: Chemical agent injury diagnosis/treatment
CD 3: Transportable isolation system
CD 4: Patient respiratory/eye protection
CD 5: Advanced NBC collective protection

ID 1: Operationally relevant vaccines/medications
ID 2: Advanced distributed learning capability

MOM 1: Military health surveillance systems
MOM 2: Toxic chemical detector/monitor
MOM 3: Modular deployable IM/IT systems
MOM 4: Laser bioeffects
MOM 5: WMD/emergency alert/response
MOM 6: Radiofrequency radiation bioeffects
MOM 7: Improved hearing protection
MOM 8: Protection in hypobaric environments
MOM 9: NBC biodosimetry

RD 1: Radiologic air sampling platform
RD 2: FDA approved radioprotectants
RD 3: Ionizing radiation treatment
RD 4: Nuclear/radiological personal protective equipment
RD 5: Radiation dosimeter for personnel
RD 6: Radiation prophylactic protocols
RD 7: Internal radiation dosimetry
RD 8: Improved uranium bio-assay
RD 9: Low-dose radiation biomarkers

Air Force Human Weapon (HWS) Deficiencies

Top Tier
Sustained Operations
Performance Sustainment and Protective Gear
Eye Protection against Agile Laser Threats
Bioeffects of Directed Energy
Night Operations
Simulators and Distributive Mission Training (DMT)

Middle Tier
Anthropometry
Occupational Performance Selection
Acceleration Performance Enhancement
Suboptimal Situational/Spatial Awareness
Adverse Effects of Operations at Altitude

Bottom Tier
Oxygen for Aeromedical Operations
Color Vision Performance
Nutritional and Pharmaceutical Effects on Human Performance
Human to Systems Controls