Wednesday, June 11

S17-52
074197

Session WA3
Room 3
8:30 - 11:30 a.m.

Technology - 1

PHYSIOLAB A CARDIO VASCULAR LABORATORY

D. Cauquil[1], C. Laffaye[1], A-L. Camus[1], V; Gratchev[2], I. Alferova[2], A. Kotovskaya[2], G. Weerts[3]
[1]Centre National d'Etudes Spatiales, Toulouse, France
[2]Institute of Biomedical Problems
[3]Institut de Médecine et Physiologie Spatiales

PHYSIOLAB is a cardio vascular laboratory designed by CNES in cooperation with IMBP, with both scientific and medical objectives :
- to gain a better understanding of the basic mechanisms involved in blood pressure and heart rate regulation, in order to better predict and control the phenomenon of cardio vascular deconditioning
- to provide real-time monitoring of cosmonauts during functional tests

This laboratory was launched to the MIR station in 96, and it was set up and used for the first time by Claudie ANDRE-DESHAYS during the French mission CASSIOPEE (August 96).

The scientific program is performed pre, in and post flight to study phenomena related to the transition to microgravity and to the return to Earth conditions.

Particular emphases was laid on the development of real-time telemetry to monitor LBNP test. During these tests, physiological signals are sent to the MIR control center (TSOUP) and displayed in real-time on a dedicated computer. This function was successfully demonstrated during the CASSIOPEE mission, this providing the medical team at TSOUP with efficient means to control the physiological state of the cosmonaut.

Based on the results of this first mission, IBMP and CNES will continue to use PHYSIOLAB on the Russian crews. CNES also intends to take advantage of the forthcoming French mission on MIR to improve this system, with the perspective of developing a new laboratory for the Space Station.

MEDEX: A FLEXIBLE MODULAR PHYSIOLOGICAL LABORATORY

J. Kass and G. Kampfer

PANKOSMOS GmbH, Medical and Space Technology, Munich, Germany

INTRODUCTION

MEDEX is an advanced medical experiment support system designed for space applications, whose first spaceborn application shall be during the German-Russian mission MIR'97. This paper will describe the system and it's operation philosophy; it will also present how the system can be expanded with additional modules as required.

SYSTEM OVERVIEW

The Medex design concept is based on the integration of medical instruments into small, battery powered Measurement Modules, which transmit physiological data via an infrared link or via cables to a Central Data Unit (CDU). A laptop computer serves as an intelligent terminal of the CDU offering capabilities for numerical and graphical display of procedures and data as well as for command input via keyboard. The Central Data Unit provides for data acquisition and extensive real-time processing capabilities as well as high data storage capacity. Although interfaces to the MIR orbit-to-ground data links are available, the prominent feature of the system is its ability to support medical experiments without ground-based assistance.

At present there are five modules consisting of a Basic Measurement Module (ECG, Respiration, arterial blood pressure, temperature, EMG) an Impedance Measurement Module including Electrical Impedance Tomography, a Micro-Circulation Diagnostic Module, Portapres, a Stressor Module (pressure cuffs for the thighs, static ergometer, and LBNP pump control), Cranial Doppler. There is also a Vest for carrying some of the miniaturised modules about the test subject. All modules have a power interface connector, and may be supplied by an accu pack or by a central power supply.

OPERATIONAL PHILOSOPHY

The Central Data Unit allows for easy access to the various circuit boards, which makes exchange of specific interface boards for future reconfiguration of the system a relatively simple task. This unit also includes a power converter and a battery charging device for the accumulators. A second power converter is designated for peripheral units with high power dissipation like a pump system for the LBNPD, a Cranial Doppler Module and a Stressor Module, as required for the specific experiment scenario.

The experiment operation is supported by the laptop computer. As soon as the computer is switched on the test subject is permanently guided by the experiment procedure being displayed on the screen of the computer. For each step the subject is prompted and has to verify his activity by pressing ENTER. Errors or critical parameters are visually and acoustically indicated. All relevant physiological signals are acquired, analyzed and displayed on-line, thus allowing the subject at every moment to be fully aware of the ongoing experiment. The reaching of a hazardous condition will immediately lead to an automatic shutdown of the stimulation device or the whole experiment.

Beside the preprogrammed nominal mode there are capabilities for the test subject to intervene himself. He can deliberately change preset parameters within the allowed ranges. He can switch to off-nominal experiment procedures and repeat or skip certain experiment phases.

This concept allows for the test subject being able to perform most activities of even complex experiments all by himself and with very little risk of operational failures. Thus, the extremely precious resource of crew time can be reduced to a minimum.

MODULAR PHILOSOPHY AND FUTURE PLANS

Because the Medex system is concieved and built in a modular manner, it is possible to run it with any combination of modules, which are linked together with Daisy Chains. In this manner not only is the set-up and operation simplified depending on it's application, but it is possible to extend the system in the future. In the past, complex systems have been built at great cost for a space mission, to become obsolete before a chance of reflight offers itself. With Medex, it is possible to add a new module or replace an outdated module relatively simply; an identical system exists on the ground where such changes can easily be tested and verified. Some new modules being considered for the future are a dedicated EMG module and an EEG module,

Mailing Address:

Dr. J. Kass
PanKosmos GmbH
Robert-Koch-Strasse 2
82152 Planegg, Germany

Phone/ Fax: +49 - 89 - 899 342 44

A Sensate Liner for Personnel Monitoring Applications

Dr. Eric J. Lind
NRaD, San Diego, Ca.

Dr. Sundaresan Jayaraman
Dr. Rangaswamy Rajamanickam
Ms. Sungmee Park
Georgia Institute of Technology, Atlanta, Georgia

Dr. Robert Eisler
Mission Research Corporation, Fountain Valley, Ca.

Mr. Gil Baird
Mr. Dave Cadogan
Mr. Tony McKee
ILC Dover, Frederica, De.

This program develops and demonstrates technologies useful for implementing a manageable cost effective systems approach to monitoring the medical condition of personnel by way of an instrumented uniform hereafter referred to as a *Sensate Liner* (SL). The SL consists of a form fitting garment which contains and interconnects sensing elements and devices to an electronics pack containing a processor and transmitter. The SL prototype requires fiber, textile and garment development. The SL textile consists of a mesh of electrically and optically conductive fibers integrated into the normal structure (woven or knitted) of fibers and yarns selected for comfort and durability. A suite of SL garment compatible embedded biological and physical sensors are then integrated into the SL. The initial SL sensor suite is selected to improve triage for combat casualties. This mesh forms a conductive backplane hosting and integrating sensors for biological phenomenon such as blood pressure, pulse rate (heart rate), etc.; physical sensors including - barrier penetration, motion, position etc.; environmental sensors such as temperature, etc.; while including ultra low power alert and monitoring technologies. The initial proof of concept suite includes sense modalities for heart rate, respiration, torso penetration (occurrence, classification and localization), and motion. Of particular interest is the detection and location of high speed projectiles penetrating the human body. Experimental results utilizing polymer acoustic transducer arrays indicate entrance wound locations can be detected with an acceptable degree of accuracy. Additional concepts for SL sensors for medical monitoring will be discussed. The SL, while individually tailored, will utilize computer automated design technologies such as laser scanning amenable to custom mass production. This work is sponsored by the Defense Science Office of the Defense Advanced Research Projects Agency, as well as the Defense Logistics Agency.

SECURE REMOTE ACCESS TO PHYSIOLOGICAL DATA

Dr. Rex E. Gantenbein
Department of Computer Science, University of Wyoming, Laramie WY 82071-3682

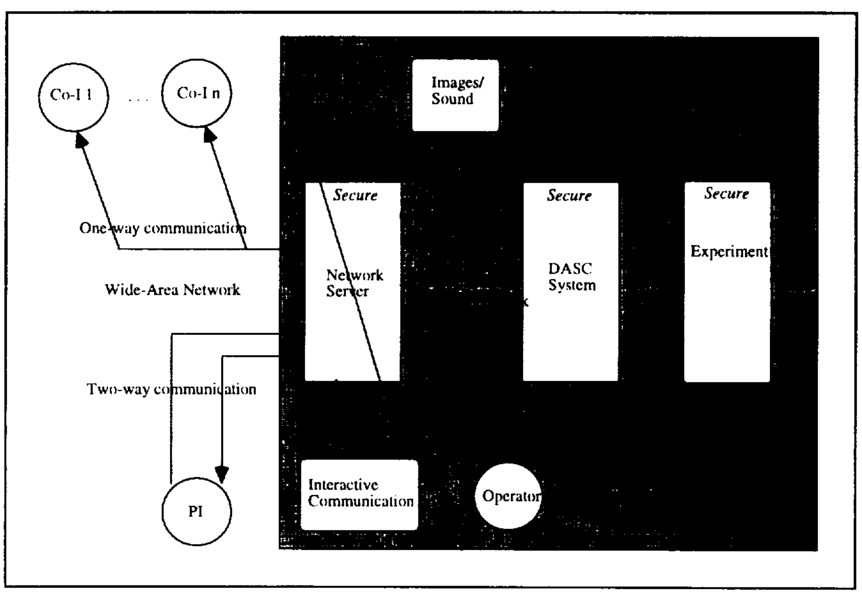
INTRODUCTION

Given the geographically distributed nature of space-based physiological experimentation, particularly in light of the International Space Station Alpha science programs, improving technologies for remote access to scientific data is an extremely important task. Freeing scientists from the need to be physically present at an experiment site allows scientific data acquisition to be more mobile and cost-effective. In addition, multiple investigators can simultaneously access and analyze acquired data, thus improving results dissemination and furthering collaboration.

However, when open technologies like the Internet are used to provide computer access to experimental data, maintaining the integrity and privacy of that data is a significant problem. Our work combines the high-quality delivery of computer-collected physiological data over networks with mechanisms to ensure the security of such data. Our approach is based on *distributed computing*, which involves using multiple computers, connected by a network, in a coordinated manner. In most stand-alone physiological experiments, data collected at a site can either be analyzed in real time by an attending experimenter, or it can be stored and forwarded to other scientists for off-line review. While the collected data can be analyzed in this latter situation, the "immediacy" of the data and the associated value of real-time review of the data and feedback among the observers is lost.

RESEARCH DESCRIPTION

A distributed data acquisition system, as shown below, uses Internet technology to link computers located at an experiment site with other computers to transfer the acquired data (as well as video or sound) from the site to laboratories or offices in near-real time, providing remote observers with digital display images and audio/video communication links to the site. This allows scientists with connections to the site to inobtrusively observe the subject and the images or data being acquired without being present at the site, as well as remotely interact with an operator, the subject, or even the equipment used to acquire the data.



To maintain security in this distributed system, the data acquisition and stimulus control (DASC) computer is separated from the network server, as shown in the figure. Using a *request broker* architecture that isolates all data acquisition processes from the network, a "firewall" is created that can only be crossed with proper authorization. In this way, network access is strictly controlled. Varying levels of access (including both one-way observation and two-way communication and control of the DASC system) can be provided using this architecture.

RESULTS

A prototype for a secure, remotely accessible data acquisition system is currently being implemented on a network of computers in the Distributed Computing Laboratory at the University of Wyoming, in cooperation with the Life Sciences Research Laboratories at NASA Johnson Space Center. The DASC system, which was created during the author's sabbatical at JSC, runs on a Power Macintosh using National Instruments' data acquisition hardware and Labview software. The network server is implemented on a Gateway 2000 486 machine using Windows NT and the TCP/IP network protocol. Remote access is tested on a Macintosh IIfx using viewer software, also written in Labview, that is connected to the experiment site through an Internet link and can both display acquired data from a file located on the server and start, stop, and configure the experiment on the DASC system from the remote site.

A description of the completed prototype, including performance data and security test results, will be presented at the conference.

CONCLUSION

The request broker approach to designing distributed data acquisition systems aids the development of secure systems for remote access to physiological data. With increasing emphasis in space science on improving the accessibility of data gathered from humans in space and maintaining the privacy and integrity of that data, this work has significant potential. The prototype will provide both a testbed for the evaluation of the approach and a template for development of other systems of this kind.

DARA VESTIBULAR EQUIPMENT ONBOARD MIR

P. Hofmann[1], A. Kellig[1], H.-U. Hoffmann[2], G. Ruyters[2]
[1]Kayser-Threde GmbH, Wolfratshauser Str. 48, D-81379 München;
[2]Deutsche Agentur für Raumfahrtangelegenheiten (DARA, German Space Agency) GmbH, Königswinterer Str. 522-524, D-53227 Bonn

INTRODUCTION

In space, the weightless environment provides a different stimulus to the otolith organs of the vestibular system, and the resulting signals no longer correspond with the visual and other sensory signals sent to the brain. This signal conflict causes disorientation. To study this and also to understand the vestibular adaptation to weightlessness, DARA has developed scientific equipment for vestibular and visuo-oculomotoric investigations. Especially, two video-oculography systems (monocular – VOG – and binocular – BIVOG, respectively) as well as stimuli such as an optokinetic stimulation device have successfully been employed onboard MIR in the frame of national and European missions since 1992.

The monocular VOG was used by Klaus Flade during the MIR '92 mission, by Dr. V. Polyakov during his record 15 months stay onboard MIR in 1993/94 as well as Dr. Ulf Merbold during EUROMIR '94. The binocular version was used by Thomas Reiter and Sergej Avdeycv during the 6 months EUROMIR '95 mission. PIs of the various experiments include H. Scherer and A. Clarke (FU Berlin), M. Dietrich and S. Krafczyk (LMU München) from Germany as well as C.H. Markham and S. Diamond from the United States.

VOG and BIVOG

The video-oculographic MIR hardware has been developed by Kayser-Threde in close cooperation with the ENT Laboratory of the Free University of Berlin (Prof. H. Scherer, Dr. A. Clarke), software for evaluation by Sensomotoric Instruments (SMI, Teltow). The BIVOG system, to be described in more detail, is an upgraded version of the monocular VOG MIR '92, which allowed video images of one eye to be recorded by a CCD camera mounted on a lightweight face mask. Now both eye images are obtained employing ray tracing via infrared mirrors. Thus, free-field-of-view, as well as experiments in which visible light is occluded are possible.

The video pictures are recorded on a professional studio quality Betacam recorder, which has been modified to be able to simultaneously record two monochrome images. Acceleration and rate sensors are mounted on a head frame and the data are recorded. A dictaphone (to guide the experimenter), an eye monitor (to focus) and a calibration unit are part of the new BIVOG system. A biteboard can be attached to fix the camera to the skull.

Much development effort was invested into the new binocular face mask (IR mirrors and coatings, diodes and illumination arrangements, selection of a small IR sensitive camera, optical arrangements etc).

OUTLOOK

We also will present new prototype-developments for a next generation BIVOG, which may - as part of NASA's Human Research Facility - become the 3D eye tracking system for the early utilisation phase of the International Space Station.

THE KINELITE PROJECT : A NEW POWERFUL MOTION ANALYSIS SYSTEM FOR SPACELAB MISSION

M. Venet[1], H. Pinard[2], J. Mc Intyre[3], A. Berthoz[3], F. Lacquaniti[4]
[1]Centre National d'Etudes Spatiales, Toulouse, France
[2]Matra Marconi Space, Toulouse, France,
[3]Laboratoire de Physiologie de la Perception et de l'Action, CNRS-Collège de France, Paris, France
[4]Instituto di Neuroscienze e Bio immagini, CNR, Roma, Italy

INTRODUCTION

The goal of the Kinelite project is to develop a space qualified motion analysis system to be used by the scientific community, mainly to support neuroscience protocols.
The first flight opportunity will be the Neurolab mission when the Kinelite is installed inside the Spacelab module to support the experiment "Ball Catching" (Principal Investigator : Pr. A. Berthoz, Co Investigators : J. Mc Intyre, F. lacquaniti).

HARDWARE DESCRIPTION

The main equipment, developed by Matra company, is a motion analysis system (Kinesigraph) based on real time data processing of video signals generated by CCD cameras. The points of interest are identified by small, light weight, reflective markers worn by the subject performing the experiment ; additional markers are attached to other important elements, such as the ball for the "ball catching" experiment. The markers are lighted by infra red flashes synchronized with the cameras. The system, in real time, at 200 Hz, detects the markers, computes and records on a removable hardisk, the two dimensional (in each camera CCD plane coordinate) position of these markers.
- The marker detection is based on a 2D cross correlation filtering technique giving a very good rejection of false markers (e.g. light reflection on screen).
- The marker position computation is based on a barycentric algorithm giving a sub pixel accuracy.
The three-dimensional trajectories of the markers are derived from the two-dimensional recorded positions using camera calibration data. This calibration is achieved in two steps : cameras are first precalibrated on ground, to determine the parameters relative to lenses and CCD position ; cameras position relative to each others (translations and rotations) are then determined by filming a small reference object (200 mm sized square) in the field of view. This 2 steps procedure has been developed to facilitate calibration operation in microgravity.
Other equipments, developed to support the "ball catching" experiment, include :
- an analog signal conditioner, used to acquire EMG and acceleration data
- a automatic ball launcher, able to throw a 400g silicone covered ball at various speeds from 0,5 to 3 m/s.
- a foldable seat, used to give the subject performing the experiment a confortable and reproducible position.
Algorithms used in the system are based on the commercial ELITE™ system developed and sold by Bioengineering Technology and System company (BTS in Milano, Italy).

KINELITE MAIN CHARACTERISTICS

- Camera field of view : 45°
- Number of camera : 2 to 8 (4 for Neurolab)
- Acquisition frequency : 200 Hz
- 3D accuracy : 2 mm
- Other acquired signals (at 800 Hz) : 3 acceleration and 8 EMG signals
- Main dimensions : 45 cm x 45 cm x 30 cm
- Mass : 23 kg
- Power consumption : less than 200 W

THE EXPERIMENT

The "Ball Catching" experiment objective is to examine the internal reference frames and models used by the Central Nervous System (CNS) for the interpretation of sensory informations and the coordination of motor outputs during a task of catching a falling ball.
On ground, with a 1g accelerated ball trajectory, the anticipation movement of the subject to catch the ball is linked to the initial speed of the ball, as perceived by vision.
In flight, in 0g, the ball trajectory (constant speed) will be modified compared to what the subject use to know and the CNS will have to re-learn the correct way to catch it.
Practically, the subject will be seated in a foldable seat to give reference and a 400g soft ball will be thrown toward him at various speed ; upper and lower limb movements, synchronized with muscle activities will be recorded to study the re-learn process.

CONCLUSION

By now, three complete sets of Kinelite have been delivered for Neurolab : one for training, one for the Principal Investigator, one for flight. Besides the Neurolab mission, the intent of CNES developing this equipment is to propose it for various other experiments, scientific or technological (e.g. in the robotics field) inside Spacelab, the MIR Russian station or the International Space Station Alpha (ISSA).

THE TECHNICAL EVOLUTION OF THE FRENCH NEUROSCIENCES MULTIPURPOSE INSTRUMENTS ONBOARD THE MIR STATION

J. M. Bois,[1] Y. Matsakis,[2] J. McIntyre,[3] and A. Shulenin[4]
[1]Centre National d'Etudes Spatiales, 18 avenue Edouard Belin, Toulouse, France, [2]MEDES, 18 avenue Edouard Belin, Toulouse, France, [3]Laboratoire de Physiologie de la Perception et de l'Action, CNRS-Collège de France, Paris, France, [4]Institute for Biomedical Problems, Moscow, Russia

Since the first French flight in 1982, the CNES has developed a wide range of instruments, especially in the Neurosciences. More specifically, the instrument designed for the French mission on the Russian station focused on the study of the adaptation of cognitive processes, together with the French and Russian laboratories.

This cooperation, on the one hand, between the scientists and the engineers, and on the other hand, between the French and Russian space communities, will continue during the next four-month mission in 1999.

The scientific needs that provide the basis for the development of these instruments, mainly deal with the analysis of the mechanisms employed by the central nervous system during perception of visual images, manual forces, or intervals of time, and the evaluation of the adaptive capacities of the brain when reconstructing the global perception of the body in microgravity.

The design of these instruments has considerately evolved from rather simple equipment to much more sophisticated tools that are being studied for future missions. Four steps can be defined:

- from a simple adaptation of an echograph to carry on the first neurosciences experiment (the ARAGATZ mission)
- the ILLUSIONS and VIMINAL instruments during the ANTARES and ALTAIR missions
- the COGNILAB instrument developed for the CASIOPEE mission and reused in 1997
- to the preliminary design of the 1999 mission payload, including virtual realities concepts.

These instruments include the following subsystems:

- the visual stimulation systems (from a narrow screen to a flat 8 x 8 inches LCD matrix, and to the virtual realities)
- the force feedback systems (from the first 2-axes hand controller used in the laboratories to a 3-axes instrument onboard the Mir station
- the body restraint systems (from some straps to a complex seat with a lot of accessories)
- the hardware and software systems (from a little computer to a biprocessor computer with more than 100,000 lines of code).

Besides the evolution of scientific requirements, the experience gained during the flights led to progressive improvements of these different parts. The long-duration mission in 1999 should open a new experimental area with the implementation of virtual reality concepts.

EXTENDED GROUND-BASED RESEARCH IN PREPARATION FOR LIFE SCIENCES EXPERIMENTS

M. Schuber, D. Seibt, J. Zange
DLR, Microgravity User Support Center (MUSC), D-51147 Köln

INTRODUCTION

For many years the DLR Microgravity User Support Center (MUSC) has supported external scientists in the fields of life and material sciences. For Spacelab and MIR flights scientists were supported pre-, in- and post-flight for preparing, performing and evaluating their experiments. For the support of biological and biomedical research the MUSC has set up infrastructure for experimentation in Cell and Molecular Biology, Plant and Animal Biology as well as in Human Physiology, which is offered to international scientists for extended ground based research and the preparation of flight experiments.

RESEARCH TOPICS AND DEDICATED MUSC INFRASTRUCTURE

For 0-g simulations, hypergravity experiments and extended ground based research different facilities can be utilized for integrated scientific investigations. Research topics and dedicated devices are described in the following.

For gravity related questions, MUSC offers to use equipment covering the interests both below as above 1 g, to answer scientific questions on stimulus-reaction chains on the cellular or individual level of biological samples. Clinostats can be used for the simulation of µg conditions by rotating samples perpendicular to the earth's g vector. On-line observations of small organisms will be performed with microscopical clinostats (e.g. fast rotating clinostats with CCD cameras). Larger sample volumes (as cell suspensions) are to be treated by cuvette clinostats. The Slow Rotating Centrifuge Microscope (NIZEMI), with on-line observation, is available for hyper-g applications from 1 g to 5 g. Samples can range from very small organisms (single cells, tissues etc.) or physico-chemical systems up to samples of approx. 4 cm in diameter.

Different incubation devices (10° - 36.5° C) are available for research in the fields of gravitational biology and biological processing, e.g. cell cultures, aquatic vertebrate larvae, protoplasts, fungi and plants can be investigated. Microscopical observation is enabled by a workbench with a microscope with standard techniques. Electrofusion of different cell types (protoplasts, animal cell cultures etc.) can be done.

Apart from gravitational biology research, equipment, especially suited for photochemical and photobiological studies, is available to investigate the influence of other environmental parameters on organisms or materials. The extreme environment simulation facilities are designed to expose cellular systems or biomolecules to a combination of controlled environmental conditions, such as different kinds of radiation, high or low pressure, high or low temperature, and defined atmosphere composition, and to analyze the responses to the selected parameters. Combined studies on the interaction of gravity and environmental aspects are possible.

Magnetic Resonance Spectroscopy is a non-invasive and non-hazardous tool for investigations on metabolic processes. In vivo MR spectroscopy (MRS) promotes understanding of biochemical metabolic regulations and bioenergetics in intact cells, perfused organs, animals and man. With the aid of continuously recorded ^{31}P-MR spectra changes in steady state concentrations of intermediate products of the energy metabolism like phosphagen, ATP, and inorganic phosphate can be measured. Precise intracellular pH values can be measured as an indicator for lactic acid formation and cellular acid-base regulations. For experiments on small invertebrates, thin tissue preparations or plant material the 5 mm ^{1}H, ^{31}P-solenoid probe head can be utilized.

Magnetic Resonance Imaging (MRI) is capable of demonstrating anatomical structures and pathologies in details. Our equipment can be used for whole body studies on animals up to the size of an adult rat. For the identification and quantitative examination of anatomical structures different standard MRI techniques are available. Qualitative and quantitative changes, i.e. regional capillary blood volume or temperature, in tissues of intact organisms can be measured by functional imaging method based on the Snapshot-FLASH method.

For all aquired experimental data in the a.m. fields of research, capabilities and tools can be offered to evaluate the raw measurements by video processing, image analysis, database techniques and statistics.

MEDES CLINICAL RESEARCH FACILITY AS A TOOL TO PREPARE ISSA SPACE FLIGHTS

A. Maillet, A. Pavy-Le Traon
Clinique Spatiale - MEDES, CHU Rangueil, 1 avenue Jean Poulhès, F-31054 Toulouse Cedex, France
Phone : (+33) 562.174.950, Fax : (+33) 562.174.951 and E-mail Alain.Maillet@cst.cnes.fr.

INTRODUCTION

Space research in Life Sciences is usually embedded in larger research programs related to scientific or clinical issues of health management. In the field of human physiology, this is illustrated by the main following examples: adaptive physiology, where space research deals with upcoming scientist issues and has a global approach of physiology; preventive medicine, where space medicine is beyond current achievements in occupational medicine and develops innovative countermeasures for physical fitness or health rehabilitation; clinical research, where ground based research and support to space experiments need complex and integrated multicentric studies (bed-rests, immobilization, confinement...); development of new services, such as Telemedicine in remote sites; development of new hardware and medical procedures.

MAIN CHARACTERISTICS

MEDES is an Economic Group of Interest created in 1989 by French institutions involved in manned space flights. The main shareholders are the French Space Agency and Toulouse Hospital. Other partners are two Sports Physiology Research and Training Centers (Toulouse and Aix-Marseille), the French Nuclear Research Commission (CEA) and several universities, all of them involved in space scientific programs. MEDES relies on the scientific and medical skills of its partners to ensure: Medical activities related to French and European manned space flights; Implementation of ground based simulations (studies on physiological and psychological adaptation, evaluation of countermeasures); Transfer of the skills gained in Space research to applications in Health, as for instance Telemedicine projects in remote sites, managed by MEDES; Development of links between Space research and Health industries (The OSTEOPOROSIS Project as part of the European Space agency Application Program).

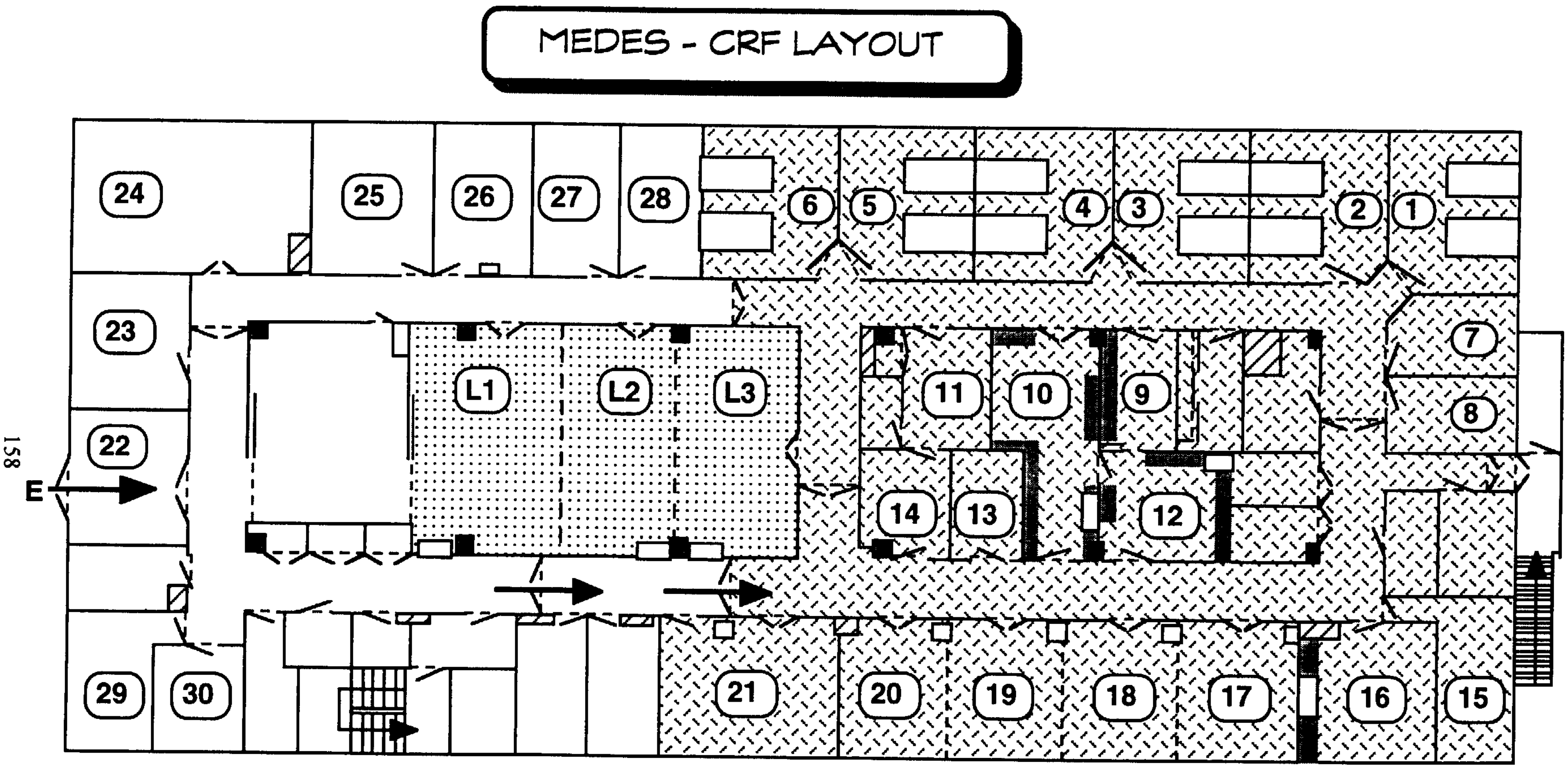
The Clinical Research Facility (CRF) is a 1000 m^2 multipurpose facility located within the Toulouse Rangueil Hospital. The CRF has been designed to host most of the ground based clinical or human factors experimental research necessary to conduct space research, as for instance: simulation of effects of space environment (bed-rest, confinement, circadian rhythms...); performance of experiment test-beds; ground based control experiments; equipment and/or procedures assessment; medical screening and check-up for healthy volunteers; training courses of students and hosting of Ph.D. students. Similar support will be proposed to Health professionals.

CRF has access to the biomedical facilities of a high standard hospital (NMR - CT scan - biological analyses...) and its own internal equipment includes the main required devices : to test and monitor specific physiological functions (LBNP - tilt table - rotating chair...); to handle biological samples. It allows monitoring of the main environmental parameters or linked to the subject such as : diet, activity (24 h video monitoring), temperature 20-25°C ± 0,5°C, acoustics (isolation of 60 dB from external environment, background less than 35 dB), and light (natural / artificial ranging from 0 to 500 Lux). CRF capacity ranges from : 4 beds for strictly controlled sleep or alertness studies, enabling blood sampling and physiological recordings without disturbing the patient, 20 beds for bed-rest studies, up to 26 beds for miscellaneous tests.

CRF is served by highly skilled professionals matching the requirements of good clinical and good laboratory practices. Services will be strictly tailored to the needs. They can be limited to a simple logistics accommodation, hosting of researchers and go up to the co-ordination of international multicentric studies.

CONCLUSION

In the frame of future long-term space flights and ISSA missions, MEDES has already co-ordinated and organized a 42 days bed-rest study, performed on behalf of CNES and ESA with the participation of 15 European research groups. Building space research on robust ground based research, developing synergies between space and health, opening space research to the widest health professionals community and therefore contribute to develop the benefits from space research are now possible objectives with the availability of a permanent and sophisticated space laboratory. MEDES, with the CRF is willing to contribute to the development of a successful utilization program of the International Space Station.



MEDES Clinical Research Facility (CRF) including three areas : 1- Office area (white part, from 22 to 30) and the main entrance (E); 2- Multipurpose laboratory zone (dotted area : L1-L3, is a 120 m^2 or 1,300 square feet) with entrance fitted for large size objects (2,50 m x 2,50 m or 8.20 to 8.20 feet); 3- The experimental zone with controlled environment (hatched area) : rooms 1-6, high quality chambers; rooms 7-8, psychomotor test laboratories; logistics zone (rooms 9-14 and 15-16); modular rooms (17-20: standing for 4 chambers, 4 laboratories or one bigger laboratory); room 21 is a specific laboratory where orthostatic tests (tilt and lower body negative pressure tests or Coriolis stress tests - on rotating chair - can be performed).