Österreichisches Weltraum Forum
Postfach 76, A-1072 Wien ‖ Technikerstr. 21a, A-6020 Innsbruck
www.oewf.org , info@oewf.org

Press Kit MARS2013

Morocco Mars Analog Field Simulation

Contents

1 SUMMARY AND CONTACT INFORMATION

Mission period:	**February 1st to February 28th, 2013**
Executive Organisation:	**Austrian Space Forum (OEWF)**
Participants:	**International organisations from the fields of space flight, outer space engineering and medicine.**

Between the 1st and the 28th of February 2013, the Austrian Space Forum, in partnership with the Ibn Battuta Center in Marrakesh, will conduct an integrated Mars analog field simulation in northern Sahara, near Erfoud, Morocco, in the framework of the PolAres research program.

Directed by a Mission Support Center in Austria, a small field crew will further the preparation of future human Mars missions by conducting experiments mainly in the fields of engineering, planetary surface operations, astrobiology, geophysics/geology, life sciences and other fields.

Contacts Austrian Space Forum

Project Leader: Dr. Gernot Grömer

ÖWF Innsbruck, Univ. Innsbruck
Technikerst. 25/8, A-6020 Innsbruck, Austria

Tel. +43 (0)676 6168336; gernot.groemer@oewf.org

Media Contact: Mag. Monika Fischer

ÖWF Vienna,
Postfach 76, A-1072 Vienna, Austria

Tel. +43 (0)699 1213 4610, monika.fischer@oewf.org

Partners:

Kiwispace. Neuseeland
Medizinische Universität Graz
Mars Society Italien
CSEM SA
ABM Space Education, Polen
UCL University College London, Großbritannien
NASA/Jet Propulsion Lab
Institut Polytechnique de Bordeaux, Frankreich
Universität Budapest
Studenten des Alba Regia University Centre,
Politecnico de Torino, Italien
Medizinische Universität Innsbruck
MPICh, Russland
Technische Universität Wien
Puli Space, Ungarn
Association Planète Mars, Frankreich

1.1 The northern Sahara as Mars test area

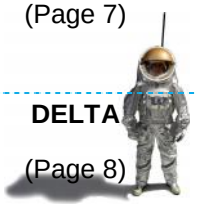
The MARS2013 Mars analog field campaign is designed to:

- study equipment behavior involving the simultaneous usage of instruments with the option of a human-in-the-loop (via the Aouda.X spacesuit);
- test life-detection or geophysical techniques, perform terrain tests for rovers and test concepts for high situational awareness of remote support teams;
- study northern Sahara as a model region for Martian deserts and extreme life; and
- serve as an outreach platform to enhance the visibility of planetary sciences.

1.2 Field test objectives

The area near Erfoud is considered as a relevant proxy for various types of geological features of Mars, as well as a diversity of paleo(micro)biological signatures, terrain topographies similar to the Martian deserts and a test site area size which requires a diligent exploration mission design. Conducting field research in a representative environment is an excellent tool to gain operational experience and understand the advantages and limitations of remote science operations on other planetary bodies.

2 OVERVIEW OF EXPERIMENTS

	Experiment	Organisation	Description
SPACE SUIT	**Aouda.X spacesuit** (Page 7) 	Austrian Space Forum	Study of contamination vectors in planetary exploration analog environments. Creating limitations depending on the pressure regime chosen for simulation.
	DELTA (Page 8)	Austrian Space Forum	Delay tests in experiment performance and live operations by a test astronaut.
LIFE SCIENCES	**COMPSTRESS** (Page 9)	Medical University of Graz	A study of analog environments (isolation but with no continuous prolonged light and darkness cycle and no hypoxia), using a non-invasive methodology and equipment.
	Long-term medical monitoring System LTSM (Page 10)	Centre Suisse d'Electronique et de Microtechnique SA (CSEM SA), Switzerland	Extending the current SENSE system with Wi-Fi capabilities given by the Smartphone.
	MAT/SEG/MEDINC (Page 12)	Innsbruck Medical University	Physiological and psychological variables tests. Comparison between satellite and cable transmission of standardized biomedical and environmentally relevant data from the Analog Mars Space.
	Microsphere and Endospore viability assay (microEVA) (Page 13)	NASA/Jet Propulsion Lab	Assess the potential for transferring biological contamination between an Astronaut suit tester and the ice cave. The assay will also study how visitors affect the microbial life in the cave.
ROVER	**CRV / Cliff Reconnaissance Vehicle** (Page 14)	Association Planète Mars, France	Further CRV concept rover testing, demonstrating hardware improvement and operations on high cliffs.
	Magma White Rover (Page 15)	ABM Space Education, Poland	Testing a laser life detector system, a high-res panoramic imaging system and an autonomous ground penetrator, which also serves as a testing device for human-robot interaction study.
	Puli (Page 16)	Puli Space, Hungary	Testing an unmanned, semi-autonomous, four "wheg" (wheel+leg) rover.
	Small Rovers Exploration Capabilities (SREC) (Page 17)	Ecole Nationale Supérieure de Cognitique, Institut Polytechnique de Bordeaux, Frankreich	Test the use of very light quads as transportation vehicles on the surface of Mars.

	Experiment	Organisation	Description
ENGINEERING AND INFRASTRUCTURE	**ERAS C3** (Page 17)	Mars Society Italy	A complete simulation of a Command, Control and Communication System.
	Antipodes (Page 18)	Kiwispace. Neuseeland	An operations experiment, where a loss of communication between the landing party on Mars and the Mission Support Center on “Earth” is assumed.
	iMAMO (Page 19)	Politecnico de Torino, Italy	Inflatable technology performance verification and inflatable structures material properties testing in a harsh environment representative of the Martian deserts.
	MarsMarokko 2013 Deployable Shelter (Page 20)	Vienna University of Technology	Testing a portable and deployable shelter, which can be set up in case of emergency requiring immediate action.
GEOSCIENCES	**Geosciences** (Page 21)	Austrian Space Forum / University of Budapest	Geoscience remote science support experiments; includes the management of all geophysical and astrobiological research activities. This also includes a set of standard geosciences techniques to be compiled during summer 2012.
	Hunveyor-4 (Page 22)	Studenten des Alba Regia University Centre, Hungary	Testing the concepts and the mostly student-built equipments for monitoring local weather and numerous environmental parameters.
	MARSES (Page 23)	MPICh, Russia	An integrated research experiment devoted to the search for water and water-ice or permafrost layers believed to exist at some depth under the visible surface of Mars.
	MEDIAN (Page 24)	University College London	Demonstrate the feasibility of detecting and obtaining a positional reference location for a methane source using data from three small "nano-landers."

3 AUSTRIAN SPACE FORUM

The Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) is a national network for aerospace specialists and space enthusiasts. Our organization serves as a communication platform between the space sector and the public; it is embedded in a global network of specialists from the space industry, research and politics.

Hence, the Austrian Space Forum facilitates a strengthening of the Austrian space sector through enhancing the public visibility of space activities, technical workshops and conferences as well as Forum-related projects.

The Forum has a small, but highly active pool of professional members contributing to space endeavours, mostly in cooperation with other - national as well as international - space organizations. The spectrum of our activities ranges from simple classroom presentations to 15.000-visitor space exhibitions, from expert reports for the Austrian federal ministry for technology to space technology transfer activities for terrestrial applications.

In summary, the Austrian Space Forum is...

- a **volunteer space organization**, led by space professionals,
- focussing on space **research** (e.g. human-robotic Mars exploration) and **outreach/education,**
- an **independant** organisation funded via research projects, donations and outreach activities.

We are the Austrian space network.

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4 EXPERIMENT DETAILS

4.1 Space suit

AOUDA.X SPACESUIT

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Contact:

Project leader: Dr. Gernot Grömer,

ÖWF Innsbruck

Univ. Innsbruck, Technikerstr. 21a, A-6020 Innsbruck

Tel. +43 (0)676 6168336;
gernot.groemer@oewf.org

- Aouda.X is a spacesuit simulator for planetary surface exploration, which the Austrian Space Forum has developed within the Mars analog research program „PolAres“. Aouda.X is able to mimic border conditions that a real Mars spacesuit would provide. The purpose of this spacesuit is to study contamination vectors in planetary exploration analog environments and create limitations depending on the pressure regime chosen for simulation.
- The outer hull consists of a Panox/Kevlar tissue with aluminum coating and the suit can perform within a tested temperature range from -100°C to +35°C.
- An advanced human-machine interface, a set of sensors and purpose designed software act as a local virtual assistant to the crewman. Aouda.X is designed to interact with other field components like the rover and various instruments.

DELTA

Image rights: ÖWF (manfredlang Visuelle Kommunikation GmbH)

Contact:

Project leader: Mag. Alexander Soucek, ÖWF

alexander.soucek@oewf.org

The DELTA experiment delivers for the first time a quantification of complexity of the Aouda.X spacesuit.

A spacesuit like the one used by Apollo astronauts in the 1960s and 1970s is essentially a spaceship that is worn. It won't be any different on Mars one day. A suit protects the astronaut from the deadly ambient conditions, which differ much from what we are used to on Earth in terms of temperature, atmospheric pressure and composition, as well as solar radiation. Many layers of protective material – thick gloves, a helmet, a life support backpack, the famous 'moon boots' – impact the visibility, agility and movability of the astronaut. But by how much exactly? DELTA will answer this question.

DELTA helps simulating flight planning for a Mars surface mission, for which it is important to know the time delay in activities caused by the spacesuit an astronaut wears. Since DELTA measures this delay, it enables precise time allocation for experiments involving the Aouda.X space suit. At the same time, DELTA allows to 'benchmark' future versions of Aouda and to address other questions like finding weak points in the suit design or comparing astronaut performance.

DELTA is based on the repeated conduct of six carefully selected dummy experiments. Each of these addresses different aspects of operating with Aouda.X, like the agility of the astronaut when walking over rough terrain or the movability of hands and fingers when working with a small technical device. Chronopoints (waypoints in time) allow to precisely measure each task. All times are finally plotted and interpreted, using the means of statistical average, to derive a DELTA value characterising the average delay to be expected when operating with the Aouda.X spacesuit as compared to the normal-life scenario of a person in jeans and T-shirt.

4.2 Life Sciences

COMPSTRESS

Contact:

Project leader: Dr. Nandu Goswami

Medical University of Graz

Tel.: +43 664 792 4948
nandu.goswami@medunigraz.at

The precise effects of isolation and confined environments (ICE) are not known. This is particularly due to differences between analog environments, as no two sites are the same and offering similar stresses. We are presently investigating cardiopostural interactions, sensorimotor adaptation, endothelial function and stress physiology in several ongoing projects that examine these aspects across different analog environments. These projects include Concordia Antarctic station (located at high altitude, isolated and with long periods of darkness and light), Indian station in the Antarctic (isolated with long periods of darkness and light but located only 100m above sea level), Slovenian Hypoxic analog site (hypoxia only) and Graz study (laboratory control). This proposal extends the study of analog environments by investigating these responses across the analog environment in Morocco (isolation but with no continuous prolonged light and darkness cycle and no hypoxia), using the same non-invasive methodology and equipment.

In these projects, we are assessing 1. sensorimotor adaptation and fatigue, using Psychomotor vigilance test (PVT) and posturography; 2. endothelium-mediated changes in vascular tone, using a non-invasive device (EndoPAT®); 3) retinal vascular diameters, measured by retinography; 4) intracranial pressure changes, measured by the hand-held, battery-driven device (Echodia Elios®); 5) heart rate variability: measured by Chronocord; 6) neuro-hormonal Function, using non-invasive salivary cortisol and salivary alpha-amylase measurements; 7) acute stress reactivity; 8) chronic stress reactivity; 9) circadian measures, using assessment of urinary melatonin; and 10) stress physiology: Using hemodynamic and autonomic monitoring and salivary hormones.

The main objective of this comparative study is to compare the above aspects of stress physiology across the analog environments. As each of these environments offer unique stressors, and because ICE conditions may interact to affect biology and behavior – and ultimately mission success – in ways the scientific and operational communities have yet to appreciate, comparing studies that clearly define the effects of each stressor are important. It should also be emphasized that each of the platforms (Antarctic stations, Slovenia, Graz control) provide a unique window into physiological and psychological processes under differing levels of stressors and each can provide important information separately and, perhaps even more effectively, if the information of each view is coordinated with the others. Therefore the Morocco analog environment represents an additional triangulation point for physiological and psychological discovery. Furthermore, comparing each study will allow us to test the hypothesis if hypoxia, isolation or altered light cycle is/are solely, in part, or not at all responsible for expected changes in sensorimotor adaptation, intracranial pressure, vascular changes, endothelial responses and stress physiology across these environments. This might lead to novel, effective, and operationally feasible techniques for crew health as well as prophylactics, monitoring tools, and countermeasures. For example, if the observed effects are due to hypoxia, the need for oxygen supplementation should be considered, at least for some time after arrival, at the Concordia station.

LONG-TERM MEDICAL MONITORING SYSTEM LTSM

Real-time monitoring of vital signs

Contact:

Project leader: Dr. Marc Correvon,

Centre Suisse d'Electronique et de Microtechnique SA (CSEM SA), Switzerland

Marc.CORREVON@csem.ch

CSEM SA is involved in the development of the continuous monitoring of a large set of physiological parameters for ESA. Moreover, CSEM is developing a less intrusive concept for sport applications. One implementation of this new concept is called SENSE, which is able to monitor:

- High-quality electrocardiogram (ECG) with dry electrodes
- Respiration by impedance plethysmographic (IPG)
- Three-axis accelerations
- Skin and ambient temperatures

From these raw signals, embedded signal processing is used to extract:

- Heart Rate (HR)
- Heart Rate Variability (HRV)
- Breathing Rate (BR)
- Core Body temperature (CBT)
- Posture classification (lying face down, face up, on the left, on the right, standing)
- Activity classification (resting, walking, running)

The SENSE system is a new approach for multi-signal monitoring using stand-alone electrode-sensors. This means that the system is wireless, where autonomous electrode-sensors are clipped in a fitting shirt. Each electrode-sensor has its own embedded electronics, a secondary battery and is able to stream data in real-time. A Wireless Body Area Network based on Bluetooth is used for the communication with a Smartphone or a tablet PC enabling the plotting of raw data or displaying the extracted parameters in real time.

For the Morocco Mars 2013 experiment, CSEM proposes to extend the current SENSE system with Wi-Fi capabilities given by the Smartphone, which will relay the signals via a Wi-Fi gateway to a server connected to the Internet. Using this configuration, the physiological signals measured on the test subject in Morocco can be displayed in real time by any client connected to the server for instance in Innsbruck or in Neuchâtel.

Image rights: CSEM

MAT/SEG/MEDINC

Image rights: ÖWF

Contact:

Project leader:
Univ. Prof. Dr. Thomas J. Luger,

Innsbruck Medical University

Tel.+43 (0)676 83144 501
thomas.luger@i-med.ac.at

Several weeks before the Mars simulation starts, each OEWF-suit tester has to undergo a strict sports medical qualifying examination, because safety is the first priority for a tester of the prototype simulation suit and is a requirement to keep risk as low as possible.

Our suit testers face a number of challenges. Beside physiological parameters, which can be measured objectively by technical devices, i.e. oxygen saturation, CO2-expiration, heart rate, heart rhythm, temperature, additional physiological and psychological variables emerge, which are difficult to measure. For example hunger, thirst and fatigue can affect the efficiency of the tester to the point where the simulation needs to be aborted.

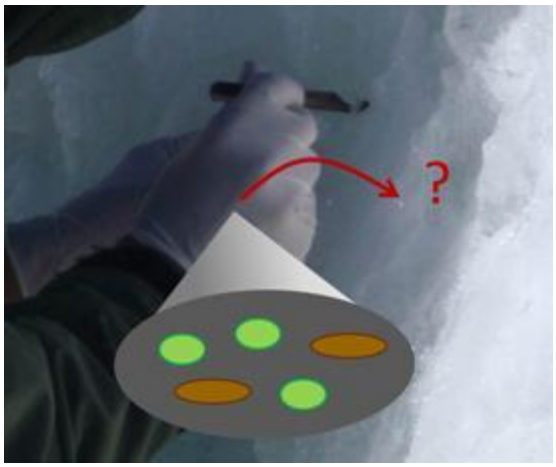
Furthermore, there will be certain parameters, which have to be captured by the astronaut relatively subjective at certain times. For instance: audiovisual abilities, fatigue, discomfort, adynamia, and pain. These are measured with the „Classification of Astronaut's present physical and psychological status". All these scores will be recorded daily, cross checked with the data and compared. Should correlations between hard objective data and subjective sensations appear, an overall picture of the astronaut's status can be determined.

The obtained data, after satellite transmission and analysis, makes it possible to establish a more optimal and individual emergency medical monitoring during EVAs as well as to improve preparations for future missions for all of our four suit testers: Daniel Föger, Gernot Grömer, Ulrich Luger and Daniel Schildhammer.

During the Morocco simulation the technical feasibility of a satellite transmission (online transfer) of standardized biomedical (Standard-ECG, „black box", Reanimation doll, no participation of the suit testers) and environmentally relevant data from the Analog Mars Space suit (O2, CO2, Humidity and Temperature) will be compared with the cable transmission.

Please reference as: Luger TJ, Winter G., Hauth S., Simonsen O, Luger U, Luger MF, Götz N, Grömer G. Telemedizinische Übertragung von medizinischen Daten einer Reanimationspuppe und umweltrelevanter Daten eines Analog-Mars-Raumanzug während Feldsimulationen - Eine technische Machbarkeitsstudie.

MICROSPHERE AND ENDOSPORE VIABILITY ASSAY (MICROEVA)



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Contact:

Veronica McGregor,
Manager, Media Relations

Jet Propulsion Laboratory
Email: Veronica.C.Mcgregor@jpl.nasa.gov

When looking for life elsewhere in our solar system during either manned or robotic missions, we will be looking for potential signs of native microbial life. Therefore, it is critical to prevent the contamination of samples taken on other planets with microbial life that has originated on Earth. This is challenging because a variety of microbes are tenacious and difficult to sterilize. One common and notable type are endospore (spore) forming bacteria. The spore is in a dormant state, where the bacterium is protected by a very resilient spore coat that allows it to survive in extreme conditions including space travel. Because eliminating spores and other resistant microbes from equipment sent to space can be difficult, it is important to investigate to what degree they are transferred from Astronauts or robots to the samples they collect in simulation studies.

The microsphere and endospore viability Assay (µEVA) experiment will assess the potential for transferring biological contamination between an Astronaut suit tester and the ice cave, using luminescent microbeads as an indicator of contamination. The assay will also study how visitors affect the microbial life in the cave by comparing the number of bacterial spores detected in ice samples taken near access paths in the cave to the number found at more pristine areas away from common traffic.

4.3 Rover

CLIFF RECONNAISSANCE VEHICULE CRV

Image rights: APM/A. Souchier

Contact:

Project leader: Alain Souchier
Association Planète Mars president
alain.souchier@gmail.com
+33607289630

Cliffs provide access to layers telling the story of millions years of geological, meteorological and possibly biological activity. One solution to explore such an area is to use a cable-suspended rover. Some artists' renderings show astronauts in space suits suspended on ropes along a vertical cliff on other planets. Such a difficult operation would only be attempted if a rover had discovered worthwhile features to explore before! Planete Mars Association decided in 2001 to assess the difficulties of mobility along a slope or cliff for a cable-suspended rover. The Association Cliff Reconnaissance Vehicle (CRV - also dubbed "cliffbot") is not a "lightweight space-qualified" design but a prototype to test the best configurations for mobility. The CRV is currently operated manually. An operational vehicle would be controlled by an electric windlass. The typical CRV payload is a camera but other payloads may be carried as well and have been experimented with.

Three CRV configurations have been tested in France and in Utah in the US Mars Society simulation habitat (MDRS). Eight CRVs campaigns were conducted at MDRS since 2002. A new campaign was conducted in the beginning of 2012 in the area of Dachstein in an Austrian cave, presenting permanent ice structures. CRV-type vehicles would also be useful to explore these dangerous areas on Mars, which may shelter present or past life indications. The Martian cave exploration simulation in Austria was organized by the ÖWF (Austrian Space Forum). One of the CRV tests was conducted by an operator in the ÖWF spacesuit Aouda.X, who gently directed the CRV over an ice cliff. Another CRV was utilized in this campaign, carrying a ground-penetrating radar developed by the LATMOS laboratory for the ExoMars European probe.

The Morocco 2013 simulation will present new conditions for CRV testing, demonstrating hardware improvement and operations on high cliffs.

MAGMA WHITE ROVER

Magma White – Mars Analog Rover

Image rights: ABM Space Education & Mars Society Poland

Contact:

Project leader: Mateusz Jozefowicz,
ABM Space Education & Mars Society Poland

email: mateusz.jozefowicz@abmspace.com

"ABM Space Education" (ABM Weltraum Bildung, ABM SE) is a Polish space startup developing analog planetary rovers for education and R&D purposes. The projects are based on successful University Rover Challenges robots and teams, including the winning Magma 2 rover. ABM SE is designing the M4K rover, an edu-toy for wide distribution, and Magma White rovers, universal mobile platforms for testing of scientific equipment developed by partners for planetary research. In 2012 Magma White participated in Dachstein Mars Simulation, carrying Wisdom georadar for the Exomars mission, among others. In 2013 Magma White takes part in the Morocco 2013 Mars simulation with various proposed experiments onboard, including laser life detector system, a high-res panoramic imaging system and an autonomous ground penetrator, which also serves as a testing device for human-robot interaction study.

With the site in Torun, Poland, ABM SE develops its own Mars analog environment – ReMY – Remote Mars Yard, a Mars terrain model accessible via the Internet. ABM SE cooperates with numerous Polish and international research institutions, such as Nicolaus Copernicus University, Torun, Białystok University of Technology, EPAR Space and EPAR R&D Center, space NGO-s including The Mars Society in US and Europe, and recently with major American public and private space technology developers. The company is Poland's first private space endeavor focusing strictly on space exploration solutions, preparing for Poland's accession to ESA.

PULI

Mobility test fort he Hungarian GLXP Rover

Image rights: T. Rapai / Team Puli Space

Contact:

Project leader:
Dr. Tibor Rapai,
GLXP Space Technologies, Hungary

tibor.pacher@pulispace.com

The Puli is an unmanned, semi-autonomous, four “wheg” (wheel+leg) rover designed by the Hungarian Google Lunar X PRIZE (GLXP) contestant Puli Space in order to explore new worlds. During the MARS2013 field experiments it aims to demonstrate its capability to be operated by remote mission control from Innsbruck and Budapest and to test its reliability and moving capabilities on extreme, hard terrain. It is a prototype version of the rover, which is planned to land on the Moon to win the Google Lunar X PRIZE competition.

The Puli, whose namesake is a popular and intelligent Hungarian herding dog breed, shall also test its thermal and mechanical stability, the efficient and reliable communication between its subsystems, its power usage control, and solar panel charging characteristics of its batteries in the simulated extra-terrestrial environment. In addition, the Puli will use stereo cameras as “eyes” to image its surroundings, from which a 3D map will be generated by mission control to direct the rover’s movement remotely. Autonomous rover behaviour scenarios shall also be tested by simulating emergency situations. Finally, the rover may carry other scientific instruments as well.

Puli Space Technologies Ltd is a Hungary based company developing solutions for a new era of commercial space exploration. Founded in 2010, the company now enjoys the support of a large group of voluntary professionals, an ever growing list of forward-thinking investors, and thousands of individual supporters.

www.pulispace.com

www.facebook.com/pulispace

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www.twitter.com/pulispace

http://www.googlelunarxprize.org/teams/team-puli

The **Google Lunar X PRIZE** competition is the 21st century’s race to the Moon. The X PRIZE foundation will reward teams from its 30 million dollar purse that are able to land a rover on the Moon by 2015 and perform given tasks including movement of >500m while transmitting back high quality pictures and near-real time videos to the Earth.

SMALL ROVERS EXPLORATION CAPABILITIES (SREC)

Image rights: Association Planète Mars

Contact:

Project leader:
Dr. Jean-Marc Salotti,
Ecole Nationale Supérieure de Cognitique,
Institut Polytechnique de Bordeaux, France

jean-marc.salotti@ensc.fr

The objective of our project is to test the use of very light quads as transportation vehicles on the surface of Mars. In a recent scenario for sending humans to Mars it is suggested that the landers will have to be very light, which means that the number of astronauts per lander will be small (typically two landers with two astronauts) and that the mass of the vehicles on the surface will be reduced. What can be done with two small quads? In order to answer this question, we propose to make measurements of the surface that can be explored with the quads with regards to the total surface of the respective region. In addition, we would like to investigate the concept of "portable quad." In the presence of natural obstacles like dunes, trenches or difficult slopes, it should be possible to transport the quads by hand or with the help of a simple mechanical device like a winch. The lightness of the quads might have unexpected advantages.

4.4 Engineering and infrastructure

ERAS C3

The ERAS Command Control and Communication (C3) System

Contact:

Project leader: Franco Carbognani,

Italian Mars Society
franco.carbognani@marssociety.it

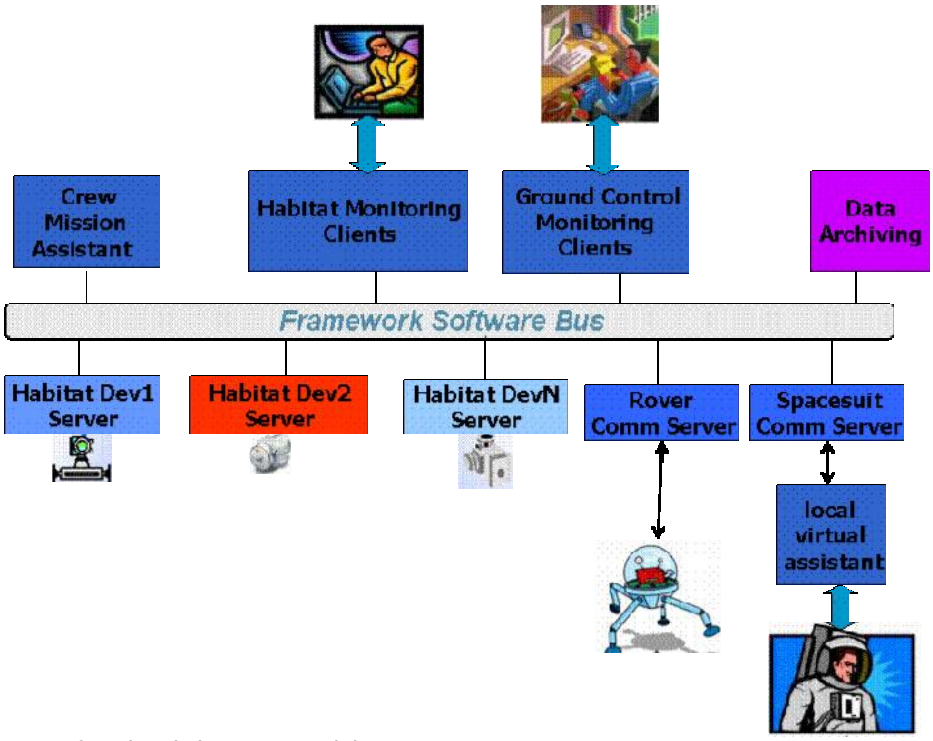
Crewed planetary exploration missions will be complex and highly demanding, both for activities in laboratories and Extravehicular Activities (EVA). The human crew will have to interact with a diverse team of mobile robots operating in a variety of control modes.

To deal with this complexity there is a clear need for a concise and coherent design approach. Inadequate usage of technology will result in decreased task performance and may even increase the risks for astronauts' health. In addition to the requirement of excellent usability, the technology should provide excellent cognitive support to perform nominal and off-nominal actions. The overall system must be able to integrate many modules, including sensors, graphical interfaces and navigation software. We will refer to

such a system as the Command, Control and Communication (C3) system. In supporting crewed planetary exploration missions, C3 will be facing all the issues associated with monitoring, assessing, and controlling heterogeneous multi-component and multi-degree-of-freedom systems.

Within the C3 system the crew mission assistant will constitute the "facility" side of the ubiquitous computing environment that will support the crew at any time and place during their planetary exploration missions. The crew mission assistant will cooperate with the astronauts to accomplish safe, effective and efficient operations and will substantially enhance the human-machine's team resilience.

We intend to build a complete simulation of a C3 system as part of the European MaRs Analog Station for Advanced Technologies Integration (ERAS) program spearheaded by the Italian Mars Society. The main goal of the program is to provide an effective test bed for field operation studies in preparation for manned missions to Mars.



ERAS functional chart, Image rights: ERAS

ANTIPODES

Contact:

Project leader: Dr. Gernot Grömer,
ÖWF Innsbruck

Univ. Innsbruck, Technikerst. 25/8, A-6020 Innsbruck

Tel. +43 (0)676 6168336;
gernot.groemer@oewf.org

Antipodes is an operations experiment, where a loss of communication between the landing party on Mars and the Mission Support Center on "Earth" is assumed and a parallel landing party on the other side of Mars will take over the coordination of an ongoing Extra-Vehicular Activity via their habitat, relayed via a satellite in Martian orbit.

For this experiment the KiwiMars mission at the Mars Desert Research Station (MDRS) in Utah will take over the role of the other landing party on the other side of Mars, whereas the KiwiMars Mission Control Center (MCC), located in Wellington, New Zealand, acts as orbital Mars station.

The main goal is to assess the possibility of taking over control of and responsibility for the landing party by an alternate mission support center in case of signal loss. Therefore after losing the communication to "Earth" a request will be sent to the MDRS / MCC Wellington to take over operations for the ongoing experiment and also to relay the telemetry data through MDRS / MCC Wellington. There will be several separate experiments to test the variety of permutations where different stations change their roles every time. Such a scenario has never been tested before.

iMAMO

Inflatable module to Mars and Moon

Image rights: Politecnico di Torino

Contact:

Project leader: Prof. Carrero Erasmo,

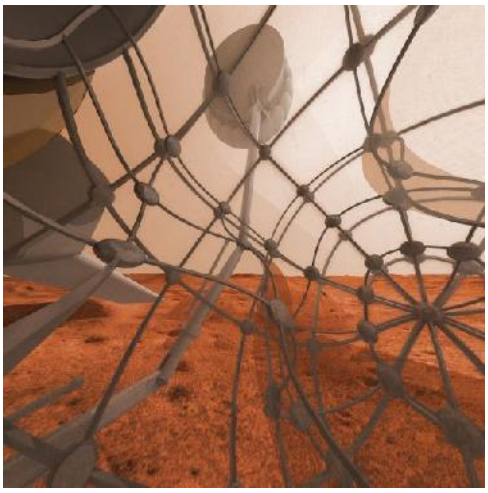
Professor at Politecnico di Torino
Department of Mechanical and Aerospace Engineering
Corso Duca degli Abruzzi,
2410129, Torino – Italy
Tel: +39.011.0906869
erasmo.carrera@polito.it

http://www.agencycentral.co.uk/agencysearch/aviation/agencysearch.htm

The iMAMO project proposes a scientific habitable module in preparation of future human Mars and Moon missions. Inflatable structures are very competitive compared to traditional metal structures. Since the 1960s, they have increasingly been studied by the most important aerospace companies and agencies of the world due to their great advantages, but simulations in a representative extreme environment have yet to be performed in order to prepare for upcoming Moon and Mars exploration missions. MARS2013 is the best opportunity to verify the performance of the inflatable technology and to test material properties in a harsh environment representative of the Martian deserts. One of the main advantages of the iMAMO module is that it can be packaged in a restricted volume in a deflated state, launched and deployed on the planet body to be ready to operate. The iMAMO module is designed to satisfy the structural safety requirements and support the payload and the mission equipment. The module includes all the subsystems necessary for the mission accomplishment and provides an automatic deployment system. The primary structure consists of an internal network of pressurized rubber hoses supporting a hemispherical external shell. The feedback obtained by the experiment will permit to make appropriate improvements to the iMAMO design and to contribute to the development of new technologies for planetary explorations.

MARSMAROKKO 2013 DEPLOYABLE SHELTER

Deployable and Portable Multipurpose Shelter Prototype
An academic project in education and research



Kontakt:

Project Leader:
Dr.-Ing. Sandra Häuplik-Meusburger,
Vienna University of Technology

haeuplik@hb2.tuwien.ac.at

Image rights: Deployable Shelter on Mars (Haeuplik-Meusburger, Lu)

Team

Dr.-Ing. Sandra Häuplik-Meusburger, DI San-Hwan Lu, DI Polina Petrova
Vienna University of Technology, Institut für Architektur und Entwerfen, Abteilung Hochbau 2

Project

The Mars surface infrastructure as anticipated for future human missions includes habitation, rover and infrastructure facilities. Referring to plans proposed by the space community we recommend an additional crew support element. The primary objective of this element shall be a portable and deployable shelter, which can be set up in case of emergency requiring immediate action and where return to the base or rover is not possible in time. The shelter shall be compactly packed, lightweight and be carried by one astronaut, similar to a “rucksack” or “suitcase” typology. It shall be easy to deploy and accommodate up to two astronauts (with space suits), e.g. one injured astronaut and one helper astronaut. It shall temporarily provide a breathable atmosphere for a minimum duration of up to 48h until rescue arrives (rover, other astronaut) or immediate emergency ceases (successful first aid, change of conditions).

The proposed project is a continuation of the investigator’s and the department’s activities and is conceived as an academic teaching and research project. A 1:1 prototype shall be tested during the field simulation as part of the concept study for a deployable and portable multipurpose shelter. This prototype is developed and built by a group of master students of architecture at the Vienna University of Technology. It is a simplified mock-up of a deployable pneumatic structure. An outer layer provides protection (sandstorms, radiation, abrasion, etc.) and can be adjusted to the topological conditions of the deployment site (rocks, uneven terrain, etc.). The volume and shape of the primary structure can be adapted according to astronaut activities.

A team of three students will test the operability (deployment and retraction), the durability (multiple deployments), function (human/equipment shelter) and adaptability (functional usability) on-Site in Morocco. Issues to be explored include spatial usability, ergonomic suitability to actions and individual perception of comfort in relation to the activities, leading to an evaluation of the design goals.

4.5 Geosciences

GEOSCIENCES

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Contact:

Isabella Achorner

Austrian Space Forum
+43 664 9736510
isabella.achorner@oewf.org

Csilla Orgl

University of Budapest
csilla.orgl@oewf.org

During MARS2013 the “Geosciences” experiment simulates basic geological investigations under space flight conditions and makes it possible to setup an archive of samples that will be analyzed on “Earth”.

There are special training sessions to prepare the analog astronauts for the work of a geologist with a special focus on the demands of MARS2013. Besides theoretical basics of Earth Science a special focus is on work in the field. For this purpose very basic geological tasks like the usage of geological utensils and how to take a sample are trained.

Samples of rock which are taken by the analog astronauts in Morocco will be analyzed at the University of Innsbruck and Budapest to be able to make conclusions on the regional geology.

An important aspect of “Geosciences” is that, like during a real Mars Mission, the participants of this Experiment don´t know anything about the regional geology of Morocco beforehand and only have aerial photographs and some rock samples as a reference.

HUNVEYOR-4

Hungarian UNiversity SurVEYOR

Image rights: Balaton, József

Contact:

Project leader: Gyorgy Hudoba

Eötvös Loránd University Budapest, Hungary
hudoba.gyorgy@arek.uni-obuda.hu

The name HUNVEYOR is an acronym for Hungarian UNiversity SurVEYOR. The HUNVEYOR-4 is an advanced environment-monitoring robot that was engineered by the students at the Alba Regia University Centre, a campus of Óbuda University, located in Székesfehérvár.

Let us assume, we are on the surface of Mars, or another planet, and we want to know the local weather and numerous environmental parameters. We want to monitor these parameters in order to decide if we, the humans, would be able to establish a habitable space station in this location. The measured data as well as pictures can be retrieved on demand from the “Terrestrial Control Room” which can be reached via the web portal of the space probe.

The portal http://hunveyor.arek.uni-obuda.hu contains information about the project and acts as a link between the user and the probe.

The scientific goals of this terrestrial analog field study are testing of concepts and the equipment, which was predominantly built by students. This research addresses the question, if our space probe can withstand meteorological situations, like daily temperature changes, dew and dust exposure, continuous working mode, its portability and stability, the range of radio communication, and so on. The objective of this campaign is to learn what kind of measurements are required and necessary in different analog fields, and what other methods and equipment/developments are to be considered for future environment studies.

The educational goal of the HUNVEYOR-4 project is to give an attractive, exciting and meaningful long-term challenge to students in engineering and research and development. In particular we would like:

- to stimulate interest in science and engineering among young people aged 15 to 21;
- to make science and engineering an attractive career choice;
- to involve students in research and development conducted at the University;
- to provide a first-hand experience in engineering sciences;
- to study real, complex situations, not pure „sterile” laboratory subjects.

MARSES

Contact:

Project leader: Dr. Ozorovich Yuri,
Space Research Institute RAS and IKI, Russia

yozorovi@iki.rssi.ru

MARSES is an integrated research experiment devoted to the search for water and water-ice or permafrost layers believed to exist at some depth under the visible surface of Mars. There is much evidence that water once was abundant on Mars. There are stream-lined islands formed by flowing water, flow patterns reminiscent of wadis in Earth deserts, and outflow channels thought to have formed by sudden out-rush of subterranean water. Secondary tasks are the measurement of the soil properties of the subsurface of Mars, which include porosity, electrical resistance of the liquid phase, thermal conductivity, and temperature dependence.

Estimates of Martian water range from a 50 to a 500 m deep planet-wide ocean. No obvious mechanism for the escape of water from the planet has been devised. Escape of water via the atmosphere is very slow. Assuming that Mars was formed with approximately the same relative amount of water as the Earth, it must be assumed that a substantial fraction of this water remains on Mars in one form or another. It is commonly believed to be bound as ice in the polar caps and, in the ground, as ice, icy permafrost or even as water. There is also indirect evidence for widespread presence of ice, bearing permafrost and liquid phase of water through the existence of rampart craters, terrain softening, chaotic terrain and thermokarst.

In order to ensure the greatest possible penetration of the electromagnetic waves into the ground, the wavelength must be chosen as long as possible.

A main task of the MARSES system is to examine changes in subsurface properties of local regolith on Mars surface and to relate them to optical images and other remote sensing data in order to understand the nature of different terrain forms.

The responsibility for the development of the MARSES system and for the coordination of the modifications of the MARSES system and its operation will rest with MPICh, with key partners in JPL/NASA, IRE/RAS and IKI/RAS (Russia), CNRS CEPHAG and SA (France) and ESA/SSD (the Netherlands).

MEDIAN

Methane detection by in-situ analysis with nano landers

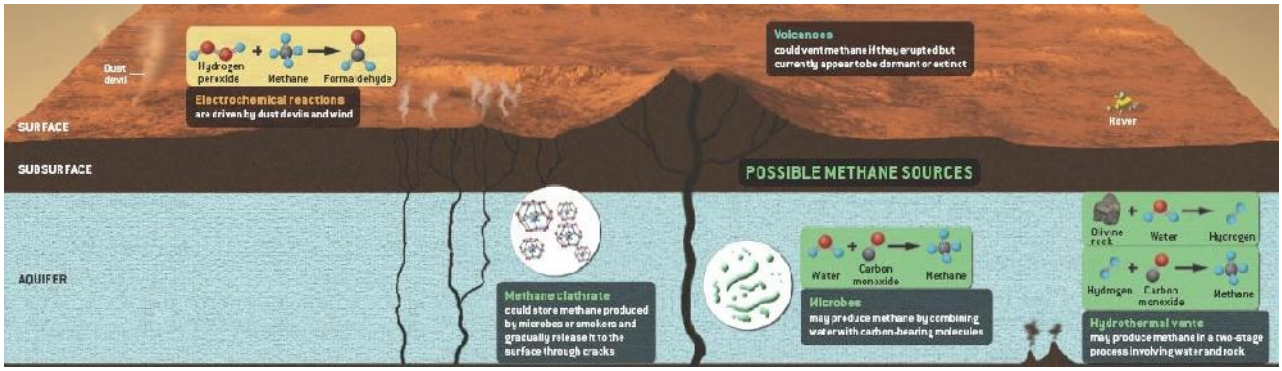

Image rights: Ron Miller

Contact:

Project leader: Jane MacArthur, BSc,
University College London

jane.macarthur@spacegeneration.org

This experiment aims to demonstrate the feasibility of detecting and obtaining a positional reference location for a methane source using data from three small "nano-landers." This will in turn demonstrate the possibility of using low cost landers to conduct surface science in association with a large-scale lander mission.

Our vision for a full-scale mission is to deploy 20 nano-landers from altitude on Mars after separation of the primary lander's backshell. The landers would use balloon assisted landing to reach the surface, transmitting data back to the primary lander for uplink to an orbiter and then to Earth. The methane detection would assist in guiding the primary lander, conceived to be a rover, to potentially interesting methane hotspots. This matrix of triangulated smaller scale landers with integrated location and transmission systems should be able to map and precisely determine the location of a local methane "hotspot," with the landing site initially chosen from wider scale methane emission readings already observed from the Mars orbiters.

Our three detectors will be placed in a simulated scaled down "drop" position in the Moroccan desert with a methane emitter and varied over the three-week simulation. We aim to determine the location of the emitter from analysing the 12-hour data readings stored on SD cards by the three arduino-based methane detectors in known locations. Heat and wind sensors will be utilised to determine weather effects on the detection process. Post phase data analysis will aim to demonstrate the viability of this method for localising the approximate position of the methane source.

Mission to Mars: T-Mobile Austria supports the Austrian Space Forum (OeWF) as its technology partner

- Simulation of expedition to Mars in the Moroccan dessert
- LTE connects the mission support center of OeWF in Innsbruck
- 10.000 times faster data connection than 10 years ago through LTE

For the second time T-Mobile Austria is supporting the Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) as its technology partner to provide mission critical online connectivity. In February 2013 the Moroccan dessert will serve as a simulation ground for an expedition to Mars. A team of 12 scientists from the fields of engineering, astrobiology, geophysics, geology and life sciences will stage a manned expedition to Mars under the direction of OeWF. The OeWF mission support center in Innsbruck, Austria, will serve as the command and support center for the scientists on the ground in the North Sahara. Mission critical data connections will be provided wirelessly by LTE mobile broadband technology. LTE routers and data sticks will connect to satellites enabling the mission support center to remotely control the mission in Morocco.

„We have started to lay the foundations for LTE deployment in Austria already in 2009. T-Mobile was one of the global pioneers of this new fast mobile broadband technology. After two years of intensive testing we were the first Austrian provider to offer its customers this new technology. We take pride in the fact that we can provide the OeWF center with the fastets mobile data connection available to fulfill its preparing for future Mars expeditions“, says Dr. Ruediger Köster, Chief Technology Officer of T-Mobile Austria.

10.000 times faster than 10 years ago

LTE (Long Termin Evolution) allows mobile data connections of up to 100 MBit per second. These speeds are necessary to move the huge amounts of data generated by the simulation of a Mars expedition, including live video streams, biomedical telemetric data from space suits and performance data from automated vehicles. A file with 4 Megabyte of data (approximately the size of a medium sized photofile) that took more than six minutes to download over GPRS technology used ten years ago can now be transferred in three tenths of a second over LTE connections. Simulating the Mars expedition produces over 30 Gigabyte (30.000 Megabyte) of data every day. Fast and errorfree transmission of these data can be an issue of life and death in a future real Mars expedition as in other applications already in use today, such as telemedicine.

Need for speed in need of frequency auction

T-Mobile Austria invests more than 100 Million Euros each year in future-proofing its mobile network for the quickly growing data demands of its customers. However, the further deployment of LTE is dependent on the auction of new frequencies. This auction was planned for this fall but has been postponed by the regulating authority due to the planned takeover of Orange Austria by Hutchison 3G Austria. A new date for the auction has so far not been announced by RTR.

T-Mobile Austria

Helmut Spudich, Unternehmenssprecher

Tel.: 0676 8200 5200 E-Mail: helmut.spudich@t-mobile.at

T-Mobile Austria has 4,060 million customers and is the second biggest mobile operator in Austria. The company is known for driving innovation in the Telco Business. Both brands "T-Mobile" and "tele.ring" address two different target groups: T-Mobile lives by the slogan "Life is for sharing" and offers innovation in regards to smartphones, services and applications. The brand tele.ring is the successful "value for price"-leader on the Austrian telecommunication market.In 2011 T-Mobile invested over € 100 million in the network with a specific focus on the roll out of HSPA+ and the next generation mobile network LTE. T-Mobile Austria has 1.400 employees. In 2011 the company was awarded as one of the most attractive employers in Austria from Aon Hewitt. T-Mobile's headquarter the T-Center is based in Vienna on the Rennweg near the "Südost-Tangente". Next to 48 T-Mobile shops T-Mobile also has sales offices in Salzburg, Innsbruck, Graz and Klagenfurt. T-Mobile Austria is a subsidiary of Deutsche Telekom AG and hence, belongs to one of the world's leading companies in telecommunications. The company's international outlook allows T-Mobile customers to benefit from a wide range of products and services, both at home and abroad

MARS FELL ON EARTH!

Spectacular addition to the collection of the Natural History Museum Vienna

Image rights: Naturhistorisches Museum

The Natural History Museum Vienna acquires new centerpiece

On July 18 2011 a very bright fireball illuminated the night sky in Morocco to announce the arrival of several pieces of rock from space. "Tissint" had arrived on Earth: it was the fifth impact of a Mars meteorite witnessed and the second largest from the Red Planet that was ever found. Mars meteorites are extremely rare and valuable. Of the tens of thousands known meteorites found on Earth, less than one hundred originated from Mars. In February 2012, the NHM was able to add one of the largest and best preserved stones of the Tissint fall to its collection. This acquisition was made possible with funds from the estate of Oskar Ermann, who was so far the most generous private donor of the NHM.

The new Meteorite Hall

On November 14 in 2012 the newly renovated Meteorite Hall will be reopened to the public. The new layout includes the core display of the original Meteorite Hall, comprised of historic glass cabinets. All previous wall display cases are being replaced with new cases that include a variety of media stations, which focus on specific topics such as meteorite impacts and craters and the origin and evolution of the solar system. The new centerpiece of the collection is the Mars meteorite „Tissint", which will be shown in a special showcase, together with other (historic) Martian meteorites in the NHM collection.

The Meteorite Collection in Vienna

The meteorite collection of the Natural History Museum in Vienna is the oldest in its form in the world. Shortly after the founding of the Imperial Mineral Collection in 1748, the custodians in Vienna started to collect meteorites. The famous iron meteorite Hraschina represents the founding object of the collection in Vienna. The iron mass fell on 26th May 1751, close to Zagreb, Croatia; it was subsequently brought to Vienna and kept in the Imperial Treasury. In 1778, the meteorite was transferred to the Imperial Mineral Collection. Due to the efforts of Karl Franz Anton von Schreibers (1775-1852) and his successors, the meteorite collection in Vienna grew to become the largest and most extensive in the 19th century. Additionally, the collection in Vienna and its custodians became one of the centers of meteorite research.

The beginning of World War I and the following collapse of the Austro-Hungarian monarchy abruptly ended the research and collection activities of the museum in Vienna. It took until the 1960s when conditions improved to renew scientific research. From then on, a small budget allowed for the purchase of selected meteorites and specimen. Today the meteorite collection in Vienna consists of more than 7,000 items from approximately 2,400 sites.

Until the end of last year about 2,200 meteorites were displayed in Hall V of the Natural History Museum. The Meteorite Hall hence contains the largest exhibition of meteorites in the world. Based on its long history and efforts of its custodians, the exhibit is rich in historically significant objects. Some of these valuable meteorites have a direct link to the founding of meteorite research as a scientific discipline. As such, the collection in Vienna has a worldwide reputation with scientists and private collectors alike.

Press Kit to Download (German Only):
http://public.nhm-wien.ac.at/Meteoritenankauf.zip

For additional questions:

Mag. Irina Kubadinow

Head Public Relations, Media & Press

Tel.: ++ 43 (1) 521 77 DW 410

Mobil: 0664 415 28 55
irina.kubadinow@nhm-wien.ac.at

Mag. Verena Randolf

Public Relations & Media Assistant

Tel.: ++ 43 (1) 521 77 DW 411

Mobil: 0699 81642277
verena.randolf@nhm-wien.ac.at

Contacts Austrian Space Forum

Project Leader: Dr. Gernot Grömer

ÖWF Innsbruck, Univ. Innsbruck
Technikerst. 25/8, A-6020 Innsbruck, Austria

Tel. +43 (0)676 6168336; gernot.groemer@oewf.org

Media Contact: Mag. Monika Fischer

ÖWF Vienna,
Postfach 76, A-1072 Vienna, Austria

Tel. +43 (0)699 1213 4610, monika.fischer@oewf.org