

"V-ERAS: A Virtual Environment for Planetary Exploration Crews Training"

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--- ABSTRACT ---

The European MaRs Analogue Station for Advanced Technologies Integration (ERAS: www.erasproject.org) is a program spearheaded by the Italian Mars Society (IMS) which main goal is to provide an effective test bed for field operation studies in preparation for manned missions to Mars.

There are numerous technological and scientific gaps concerning the human exploration of Mars, some of which are in the fields of psychology, physiology, medicine, mission operations, human factors, habitability, robotic operations, and life support systems – all of which can be addressed using terrestrial analogs.

The scientific community has addressed a number of critical issues requiring substantial attention prior to successful return human missions to Mars. Some of these have been largely overlooked by previous analogs, and will be explicitly addressed by ERAS:

- 1. Radiation
- 2. Need for regenerative &bio-regenerativelife support
- 3. Martian dust
- 4. Planetary protection (forward-and back-contamination)
- 5. In-situ resource utilization

While there are presently numerous terrestrial Mars analogs in operation, they fail to address the majority of the aforementioned key aspects of a human mission to Mars in an integrated fashion. The ERAS will serve as a testbed devoted to the antecedent issues (among others), and will ultimately serve as a concept for a Martian outpost.

The primary innovations of ERAS compared to existing terrestrial analogs come in the areas of habitat typology, shielding, sealing, location, life support systems, and testing of electric power technologies. ERAS will be a hybrid inflatable habitat, which will significantly lower launch mass and volume for a given deployed volume. Radiation shielding, thermal mass and closed loop life support will be achieved using the new and innovative Water Walls concept. One of the major technological challenges addressed by ERAS will be the construction and operation of such a habitat module. Testing of photovoltaic power generation systems with regenerative solid oxide fuel cells will be undertaken at ERAS, along with testing of other proposed technologies. ERAS will be located in an accessible region in Europe, such that costs of logistics, operations, and research are minimized, and education/outreach opportunities are exploited. ERAS will enable researchers from all over the world to conduct experiments pertaining to nearly all aspects of a crewed Mars mission in a high-fidelity analog.



Preliminarily to its construction, IMS has started the development of an immersive Virtual Reality (VR) simulation of the ERAS Station (V-ERAS). The major advantage of such virtualization is that it will be possible to undertake training sessions with a crew that can interact with its future environment before the actual station is built. This way a more effective design of the station and associated missions and a strong reduction of costs could be obtained. The main objective of this activity will be the achievement of adequate fidelity simulations and validation of the data obtained during the training sessions so that they can be used for the design of the station itself. Many ergonomics and human factors will be considered in the virtual model in order to be verified and validated before the actual ERAS habitat construction.

The development effort is currently divided in three main activities:

- ERAS Station simulation using an appropriate game engine supporting a virtual reality headset
- Upper body and hands gestures tracking
- Integration of an omnidirectional treadmill

The final goal will be the construction of a classroom in which four (or six, depending on the targeted crew size) VR stations will be installed and the definition of appropriate crew rotations in which different training sessions are performed.

Keywords

Terrestrial Mars Analogs, Virtual Reality, Human Factors, Crew Training

--- SUNTO BIOGRAFICO DEGLI AUTORI ---

Antonio Del Mastro

Antonio Del Mastro, President of the Italian Mars Society, graduated summa cum laude in Electronic/ Telecommunication Engineering in 1993 (research sector: SAR satellites data analysis). In the next years he acquired project management and technical consulting experience with companies of the packaging / iron and steel/ chemical industry.

In 1999 Mr. Del Mastro set up STUDIO DM, further named Aldebran, a consulting company working mainly in the areas of : plants engineering and project management, certification of industrial plants and machinery, risk analysis (http://www.riskanalysis.it), innovative compound materials (www.materialicompositi.com), technical documentation / writing.

In 2005 Mr. Del Mastro established the Italian Mars Society (<u>www.marssociety.it</u>), the Italian representative of the International Mars Society (<u>www.marssociety.org</u>).

In 2009 he organized in Bergamo the Ninth European Mars Society Convention and started to publish as editor the technical review "Mars Transactons".



Mr Del Mastro is currently director of ERAS (<u>www.erasproject.org</u>), a project carried out by the Italian Mars Society concerning the construction in the Bergamo area of a Mars Simulation Laboratory.

Franco Carbognani

Franco Carbognani, Science and Technology Coordinator Italian Mars Society, is currently Head of Interferometer Operation Department supporting the Virgo Gravitational Wave Detector Project at the European Gravitational Observatory (EGO) in Pisa, Italy. In particular he is providing onsite Software Engineering support and participates in all the efforts related to the control of a large experimental facility and the integration of heterogeneous industrial subsystems.

He holds an MSc with double Major in EECS (Information Technology/Hardware Engineering) from the University of Bologna and CEFRIEL Research Center in Milan. Franco professional experience focus on the areas of Control Software, Software Engineering and System Level Design both within large international companies and research institutions. He has previously worked for the Very Large Telescope (VLT) Project at the European Southern Observatory (ESO) in Munich. Franco served as a Commander and Lead Engineer for the MDRS Crew 102 Mission (http://desert.marssociety.org/).