IDE
INNOVATION DESIGN ENGINEERING

MARS

Royal College of Art Innovation Design Engineering and Vehicle Design students, collaborated in inter-disciplinary teams to design a Mars Space Rover with consideration of both physical and psychological conditions in order to assure comfort, high habitability levels and safety for astronauts. / 2011

Introduction A few years ago the closest that designers came to space would be designing props for Hollywood sets. Now, in parallel with successful launches by private enterprises including Virgin Galactic and Space Adventures, a new context for designers has emerged. On 15th April 2010, US president Barack Obama predicted his new space exploration plans would lead American astronauts to Mars and back in his lifetime, a bold forecast relying on rockets and propulsion systems yet to be imagined and built. "By the mid-2030s, I believe we can send humans to orbit Mars and return them safely to Earth and a landing on Mars will follow." Predicted space travel towards the Moon and Mars is forcing space agencies and private companies to design, realize and test pressurized surface rovers to host astronauts during planetary missions. This is an extreme environment for combining innovation, design, automotive and engineering skills as 'space design'. Designing for space requires clever simulation and mapping skills to understand the environmental design parameters, both physical and psychological. We can never experience these effects on Earth so our imagination provides a powerful design tool.

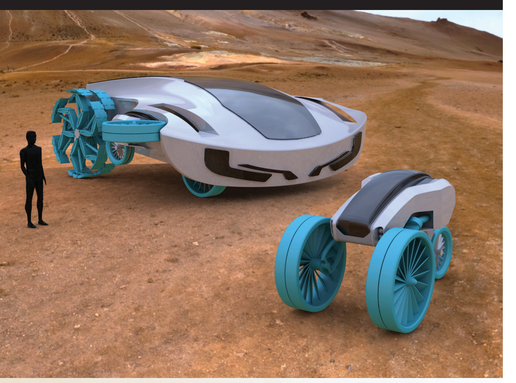
Brief Dual masters Innovation Design Engineering and Vehicle Design students collaborated to design a Mars Space Rover with living and greenhouse space, considering both physical and psychological conditions in order to assure comfort, high habitability levels and safety for astronauts. This new inspirational field for design creatively exists in an extreme environment and encourages innovative solutions to cope with the different environmental conditions, limitations in habitation module size, forced dependability on a closed life support system, psychological and sociological risks. Design teams were required to take into account the necessity to minimize weight, volume and energy consumption of all functional elements inside the rover and to propose a ConOps (concept of operations) from the initial Earth launch vehicle to Mars landing and return.

Thanks to PRAMAC for supporting us in producing models of the Mars rovers, Thales Alenia Space for launch and space environment expertise and to NASA for a tele-conference on habitation and interplanetary technology futures.

Module Director /
Ashley Hall
Deputy Head of the Innovation Design Engineering Programme,
Royal College of Art
ashley.hall@rca.ac.uk

Module Leader /
Daniele Bedini
"ISS"
bedini@isspace.it

PRAMAC
iGuzzini
ThalesAlenia Space

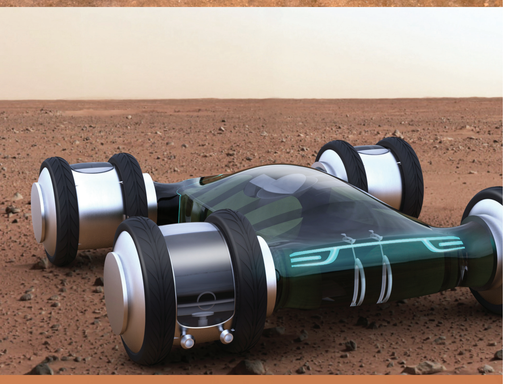


BOREA

Intended as an all-encompassing living & research facility, its ultra-insulated shell and regenerative systems capture resources available on the surface of Mars, allowing BOREA to be completely self-powered.

Equipped with climate-adaptable lighting, BOREAs exterior allows for it to achieve maximal visibility. Light intensity is adjustable both automatically and manually in order to accommodate changing environmental conditions, such as the frequent dust storms on Martian surface. Wheels are independently suspended and lit in order to fulfil highest manoeuvrability. Back wheels of BOREAs main cabin are expandable in size, hydraulically operated & reinforced for traction on rough Martian terrains. Taking advantage of the plethora of wind on Mars' surface, BOREA detects formidable winds according to its own direction of travel, hovers its front half while catching wind with its cleverly engineered exterior shell as sail, conserving energy usage while preserving speed.

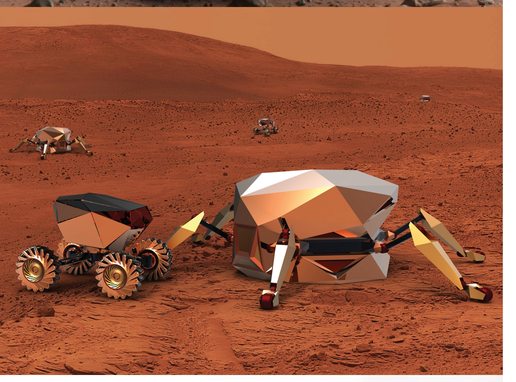
Mimi Zou / IDE
Luc Fusaro / IDE
Chulhun Park / VD



MARS SPACE CAPSULE

The concept of our Mars Rover was designed around the contest of preservation of the human race. The year is 2050. Earth is polluted irreversibly, and humans must look for new resources to avoid pending extinction. The United Nations decide to fund a space expedition to build and sustain a greenhouse on Mars for a period of two years. The expedition is broken into two launches: first, the greenhouse, followed by crew and rovers once the greenhouse lands safely on Mars. The greenhouse is designed to be a modular entity that becomes mobile when the four individual Mars rovers attach and become one-quarter of the wheels needed for mobility. The individual rovers act as private quarters for the crew, as well as personal vehicles for solo expeditions across Mars terrain. The greenhouse acts as both, a central hub of oxygen and food production, as well as a hub of communal/social interaction. The energy production for the greenhouse and rovers is mainly solar and contributes to the system of food/energy production to sustain the man-made closed loop ecosystem.

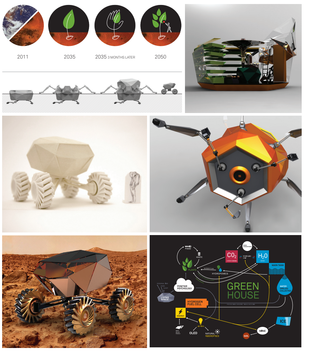
Chris Pinches / IDE
Kevin Bickham / IDE
Nevin De Paravicini / VD
Kyungeun Ko / VD



MISSION TERRA FORM

The aim of the next two missions to Mars is to prepare the planet for future colonisation. This is to be achieved through 'planting' greenhouse modules on the surface of Mars. The modules would be a mix of greenhouses for food production, and botanical gardens for plant systematic research.

The first mission is to send fully automated modules to Mars to start the initial seeding process. The units would automatically dig themselves into the ground for insulation. The second mission is a follow up with a two part vehicle and four crew members to carry out harvesting and expanding the greenhouses as well as conducting evolutionary plant research in the botanical modules. One large habitation unit, can attach itself on top of the greenhouses to allow the crew to move freely between the two spaces. The small rover vehicle, can be used for short exploration missions between the greenhouse stations.

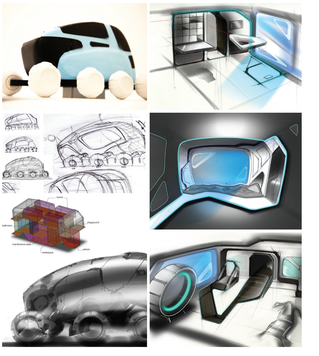


Alicja Pytlewska / IDE
Peter Krige / IDE
Jeehoon Shin / VD
Teeravit Hanharutaivan / VD

ULYSSE

Designed around the psychological requirements of a crew of four astronauts on a fifteen month round trip, the interior of Ulysse is designed to provide the four-man crew with a combination of permanent private space and flexible communal areas.

A personal room is important on such a long trip to give each crew member their own home territory in which to rest and reflect, that can be customised by the astronaut in-flight. Flexible communal areas can be quickly re configured for work or recreation activities to make best use of space and to operate in both micro and Martian gravity.



Audrey Gaulard / IDE
Matt Batchelor / IDE
Larry Finnegan / VD
Paul Nichols / VD
Adam Setter / VD
Henry Cloke / VD

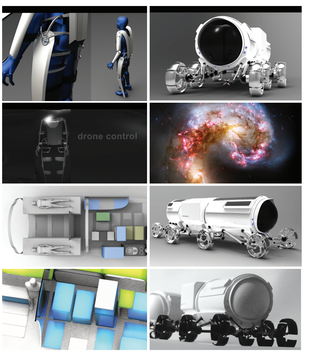
EXO ROVER

Hardware is an extension of humanity's muscle power, software is an extension of humanity's mental power

The project's aim was to create this psychological comfort and safety for the crew by delivering well designed tools with a use of modern technology.

Both rovers are controlled by an exo-skeleton. This empowers the crew with full control over the vehicle, including control of the arms, full feedback for use with virtual reality and gym exercise — or maybe you want to go for a swim in the Bahamas. A small robot controlled by the exo-skeleton was designed, which could be used to collect samples outside the rover.

The rover separates work and home, an important psychological aspect, and there are OLED screens that visually connect the two rovers when separated. An OLED system in the home interior creates a changeable ambient, whilst the folding systems of storage and furniture allow space to be saved.



Joel Trotter / IDE
Ho-Tzu Cheng / IDE
Jan Barcentewicz / VD
Pablo Velasco Migoya / VD

MISSION MOTHERSHIP

MotherShip is a concept for space travel to Mars, inspired by the idea of putting life on the Red Planet.

"Mission MotherShip" is set for the year 2051, and would conceivably be the third or fourth mission to Mars. The objective is to send a crew of four astronauts, one of whom is pregnant. The seven month voyage would be the majority of the pregnancy, and the eighth and final month would be spent on the planet where the first "Martian" will be born.

The Mars habitat is a two-level inflatable structure separating work and relaxation. The bottom supports equipment for a birthing scenario, and medical equipment. The top level includes an eating and resting area, with self-sustaining greenhouses.

Four small rovers attach to the main habitat, providing private sleeping areas.

Seung Rhee / IDE
Nick Paget / IDE
Chi Min Hwang / VD
Niels Vanrooij / VD