



Artificial gravity, stress and a controlled environment

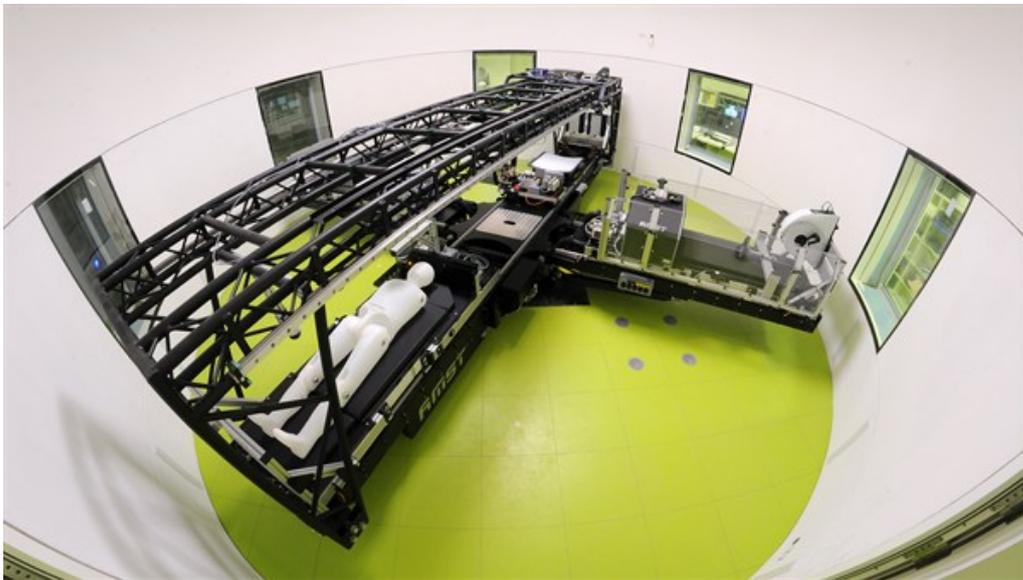
05 July 2013

DLR opens globally unique :envihab research facility

A short-arm centrifuge spins test subjects at six times Earth's gravity; a hypobaric chamber simulates an altitude of 5500 metres; and in the Psychology Laboratory a shuttle has to be docked with the International Space Station under stressful conditions. The focus of the new :envihab research facility, operated by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), and its eight modules, spread over 3500 square metres, is on people, their health and their performance levels. ":envihab is the only facility in the world with this configuration and these capabilities," says Rupert Gerzer, head of the DLR Institute of Aerospace Medicine. Here, researchers will not only focus on astronauts, but on people on Earth as well. "Something that makes an astronaut more efficient can also help a patient here on Earth – and vice versa."

Rotating at 6-G

You can guess from outside what the centre of the facility contains. It is a circular area, and inside, the short-arm human centrifuge rotates, generating artificial gravity for the test subjects. During space missions, as astronauts work and conduct research, their bones and muscles deteriorate, the efficiency of their circulatory system is reduced (as a result of microgravity) and their immune system becomes weaker – the gravity generated in a session in the centrifuge might counteract these physical changes. "Using the centrifuge, we want to conduct research to discover how and to what extent this might happen," says Gerzer. During the session, the test subjects might be subjected to artificial gravity six times that of Earth's. They are also expected to carry out other tasks as part of this experiment: for example, they might have to do exercises on a static bicycle or a springboard, which can sometimes further reinforce the effect of the centrifuge session. Multiple cameras monitor the sequences of movements as they do so. One globally unique feature is the option of using a robotic arm to perform an ultrasound screening on the test subject during the centrifuge session and observe the heart. "First, we will carry out studies in which we can understand and use these research options very specifically." The aim in future is to deliver a custom-made centrifuge to space for astronaut training. Scientists will develop countermeasures for bone and muscle deterioration following a lengthy confinement to bed or in old age here on Earth.



The short-arm human centrifuge rotates, generating artificial gravity for the test subjects (Image: DLR)

Resting for science

The other modules are in the immediate vicinity of the centrifuge. In future the Sleep and Physiology Laboratory will be used to conduct bed confinement studies lasting several weeks or months. Up to twelve test subjects can be placed there under precisely controlled environmental conditions. Humidity, oxygen, nitrogen and carbon dioxide levels, ambient light and temperature can all be precisely set and adjusted according to the research being conducted. Special light covers also enable experiments using different wavelengths. "Astronauts are shift workers just as much as factory workers or nurses and doctors on night shifts," says Gerzer. Research into which wavelengths favourably affect the rhythm of shift workers will benefit workers in space and on Earth. Additional areas of research will be bone and muscle deterioration, the circadian rhythm and the effects of nutritional variation.

Looking at the body and brain

One of the installations in the :envihab research facility is a magnetic resonance imaging (MRI) device with positron emission tomography (PET) capabilities. With this instrument, researchers will be able to investigate – right on site, just a few metres from the various modules, such as the Sleep and Physiology laboratory or the centrifuge – for example, where the human body stores sodium, water and fat content levels, and how the body is supplied with blood. It is also possible to make neuroreceptors in the brain and processes associated with them visible. "The shortness of the trip from the test subject room to the MRI guarantees that the selected environmental conditions and the position of the test subject are not altered during the trip."

In the Prevention and Rehabilitation Laboratory, scientists are investigating the cardio-pulmonary system and the human musculoskeletal system, as well as the effects of atmospheric conditions on the body. In the hypobaric chamber, conditions are created to simulate altitudes of up to 5500 metres. The Physiology Laboratory will be used to study ways to counter the negative effects of zero gravity. Various types of equipment are available to, for example, measure muscle strength and performance. The adjacent Biology Laboratory contains multiple laboratories for analysing microbial load and preparing biological experiments for space.



DLR :envihab. The research facility contains, among other things, a short-arm centrifuge, hypobaric chamber, and a psychology laboratory (Image: DLR)

Work under stress

The human psyche is the subject of studies in the Psychology Laboratory. How do people react when they need to complete complex tasks under stress? What effects, for example, does a long-term mission in space have on the astronauts, who live and work with one another in very limited space and with little contact with the outside world? Here again the research results will be important for both astronauts and people on Earth. "Certain tasks require teamwork under extreme stress – no different to the work of astronauts on the Space Station," adds the head of the Institute.

The initial studies will be used to become acquainted with the equipment and facilities in :envihab. Then, a two-month bed rest study will begin. "The potential users of our facility are not just DLR scientists, but also international space agencies or universities." In future, European astronauts will come to the Cologne-based research facility after returning from space to undergo the first studies. "In :envihab, research for space flight and applications on Earth will be carried out, and both will profit from it."

Contacts

Manuela Braun
German Aerospace Center (DLR)
Media Relations, Space Research
Tel.: +49 2203 601-3882
Fax: +49 2203 601-3249
Manuela.Braun@dlr.de

Prof. Rupert Gerzer
German Aerospace Center (DLR)
DLR Institute of Aerospace Medicine
Tel.: +49 2203 601-3115
Rupert.Gerzer@dlr.de

Video: DLR opens globally unique :envihab research facility



The focus of the new :envihab research facility, operated by the German Aerospace Center and its eight modules, spread over 3500 square metres, is on people, their health and their performance levels. ":envihab is the only facility in the world with this configuration and these capabilities," says Rupert Gerzer, head of the DLR Institute of Aerospace Medicine. Here, researchers will not only focus on astronauts, but on people on Earth as well.

Credit: DLR (CC-BY 3.0).

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.