
Industrial camera with autofocus delivers perfect pictures, even under extreme conditions

# Mission to Mars

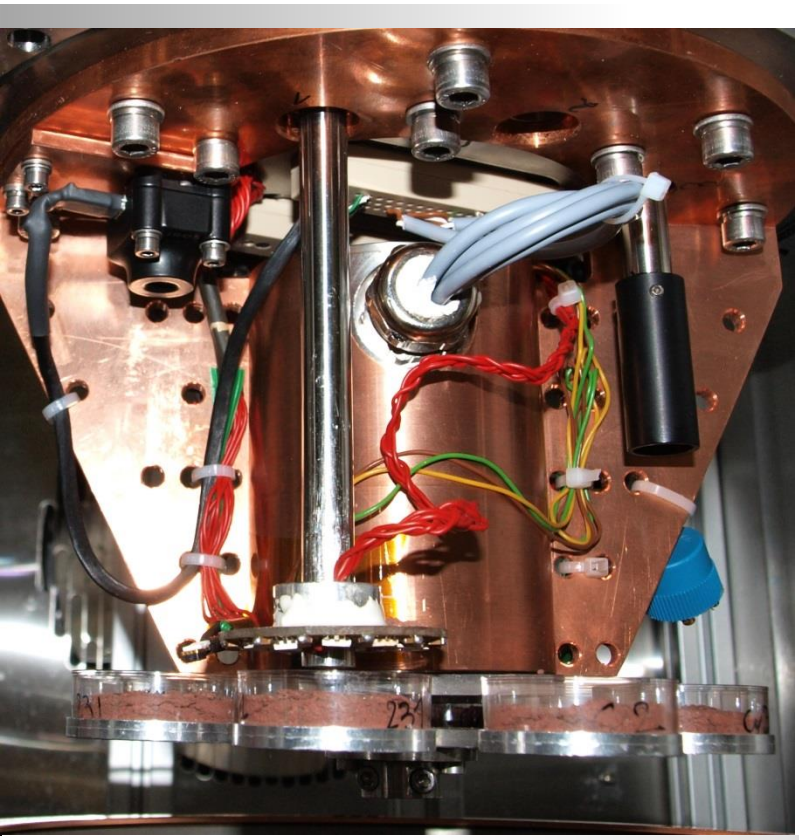
**On the Red Planet conditions are harsh, with an atmospheric pressure of about 8 millibar, an atmosphere of around 96% $CO^2$, and a relative humidity of up to 100%. Added to that, the summer temperatures in equatorial to mid latitudes range from -75°C through +20°C on dark slopes. But is Mars really so hostile to life, or could some organisms from Earth survive even under such conditions? Scientists at the German Aerospace Center (DLR)'s Institute of Planetary Research are looking into the question and investigating the activity of polar and Alpine lichens and cyanobacteria in an environment similar to that on Mars. On board the mission is a USB 2.0 industrial camera from IDS. The autofocus camera is helping the scientists to evaluate and document the experiments, and is delivering perfect images despite the extreme conditions.**

"We want to find out if there are any organisms on Earth that demonstrate metabolic processes and growth under Martian conditions," says Dr. Andreas Lorek, scientist at the Mars Simulation Laboratory at the DLR's Institute of Planetary Research, explaining the experiment. "And what are the optimum conditions? Where on the Red Planet would something be most likely to grow? At higher altitudes perhaps, or maybe in rock crevices?"

To find answers to these questions, the planetary researchers at DLR are simulating a Martian environment in a special climate chamber. The scientists have recreated the surface of Mars with various mineral constituents, based on information obtained by the Opportunity and Spirit Mars rovers on missions to the planet.

Inside the chamber, the researchers led by astrobiologist Dr. Jean Pierre de Vera have replicated the Martian atmosphere, which consists of around 96% carbon dioxide along with nitrogen, argon, and oxygen. In addition, a vacuum pump system ensures that the air pressure on the "artificial Mars" remains at approximately 6–8 millibar.

Special radiation sources from ultraviolet through infrared replicate the solar surface radiation of the Red Planet. The fluctuations in temperature ranging from around -50°C through +20°C have also been recreated. The scientists place various microorganisms (lichens, fungi, and cyanobacteria) into the extreme environment for trials of 30 days or more, and observe how the samples and surface material develop under the conditions and whether photosynthesis or metabolic processes occur, for example.



To analyze and document the processes, images are captured at regular intervals by a camera mounted in the simulation chamber. For the experiment, the researchers opted for a special industrial camera from IDS that combines two worlds: The USB 2 uEye XS.

Measuring less than one cubic inch, the tiny industrial camera (above left) was fully exposed to the harsh conditions of the simulation chamber.

(Picture credit DLR)

The 5-megapixel autofocus camera provides the convenient operation and wide range of features of a standard digital camera, along with the compact and robust design of an industrial camera.

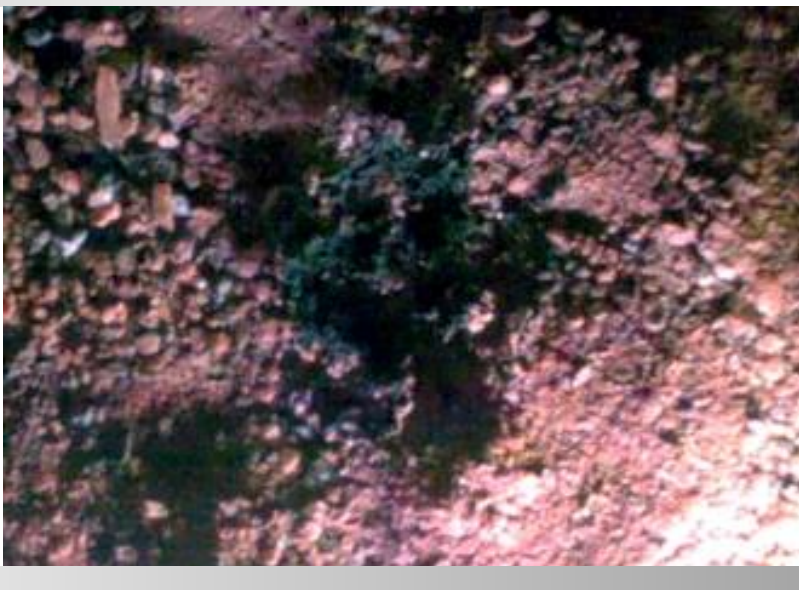
With its magnesium housing, the camera is designed for use in harsh conditions. However, conditions in the Mars simulation chamber were a true test of strength, even for the XS, owing to the high relative humidity and enormous fluctuations in temperature. "But the autofocus works perfectly, even at -50°C," says Dr. Lorek enthusiastically. "And that is despite the camera being fully exposed to the conditions. To save space, we decided not to use an additional housing; instead, we screwed the tiny camera directly onto a copper block to dissipate the heat.“

The uEye XS is one of the smallest industrial cameras in the world, weighing in at just 12 grams, and is less than one cubic inch in size (approx. 23 x 26.5 x 21.5 mm). Despite its miniature dimensions, the tiny device is setting new standards thanks to its rapid autofocus feature and many automatic functions.

Its USB 2.0 port, which also delivers power to the camera, allows it to be connected very easily to any PC or notebook. The autofocus feature delivers a crisp image from distances of just 10 cm – either automatically or manually using software. A digital zoom allows easy and almost continuous enlargement of smaller sections of the image. The 5-megapixel Aptina CMOS sensor with a pixel size of 1.4 µm delivers exceptionally detailed true-color images, with a choice of seven fixed image formats – from VGA to 5 megapixels.

The mini camera also transmits live images in various sizes up to an "HD ready" resolution of 720 p (1280 x 720 pixels) at 15 frames per second. A frame rate of up to 30 frames per second can be achieved at lower resolutions. The camera also boasts high-spec optics. The integrated lens has a 53° horizontal angle of view, which corresponds to a focal length of 35 mm in small image format. The wide aperture angle captures a field of view that is sufficient for many applications.


The USB 2 uEye XS combines the robust design of an industrial camera with the auto features of a conventional digital camera.



The microorganisms, which were observed for over 30 days in the DLR's Mars simulation chamber, included polar cyanobacteria. (Picture credit DLR)

A range of automatic image control functions, including auto white balance, auto gain and auto exposure time, are performed in the camera itself. With exposure compensation, backlight compensation, photometry and anti-flicker function options, however, there is huge scope for adapting the automatic image control.

Thanks to the mini industrial camera's wide range of automatic functions, hardly any settings need to be adjusted in most situations, and the images captured can be easily processed independently of the PC system. However, each individual parameter in the tiny camera can be changed manually if necessary using the Software Development Kit supplied.

Along with drivers and interfaces (DirectShow, TWAIN, ActiveX, and GenICam), the SDK includes a range of useful tools for capturing and viewing images. The uEye Cockpit, for example, provides access to all major camera settings and functions, and enables images and videos to be captured easily. As well as supporting Windows 7, 8, and 10, the latest release of the SDK is available for Linux and Linux Embedded – the camera can therefore be quickly and easily integrated into the relevant application.

But the DLR scientists do not require a specific application or an additional program to analyze the images in any case. The possibilities offered by the software package are fully sufficient for their requirements.

But back to the original question: Can the Red Planet support life? "Some lichens and bacteria demonstrated measurable activity and carried out photosynthesis in Martian conditions, even in trials lasting more than 30 days," says Dr. Lorek, summing up the findings. "The lichens proved to be real survivors, especially under conditions such as those found in niches in the ground or in small cracks and fissures in rocks. During the period of the trial, they demonstrated the same activity that they would in their natural habitat, such as the Antarctic.

If life arose on Mars four billion years ago, it could have survived through to the present day in niches on the surface of the planet." The results obtained by the DLR scientists will be highly instructive for future missions to Mars.

Perhaps a uEye XS will be on board the next mission to the Red Planet. It has certainly proven that it is equal to the task.

USB mini camera.

Consumer convenience for industrial applications.

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|---|---|
| Interface: | USB 2.0 |
| Sensor type: | CMOS Color |
| Manufacturer: | ON Semiconductor |
| Frame rate: | 15 fps |
| Resolution: | 2592 x 1944 Px (WVGA) |
| Shutter: | Rolling-Shutter |
| Optical class: | 1/4” |
| Dimensions: | 26.5 x 23.0 x 21.5 mm |
| Weight: | 12 g |
| Interface connector: | USB 2.0 Mini-B |


Client: www.dlr.de

DLR Institute of Planetary Research