

PRESS RELEASE

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SURPRISE - Fraunhofer IPMS spatial light modulators for outer space

Microtechnology conquers space for more precise earth observation

Earth observation is like a super detective for our planet. It shows us what's happening on Earth and even influences our daily lives, for example, through more accurate weather forecasts. As part of the EU-funded SURPRISE project, a team of experts has been investigating how Earth observation satellites can be made smarter, but also safer. Using two breakthrough technologies - spatial light modulators and Compressive Sensing - the project has developed a demonstrator for superspectral Earth observation with improved spatial resolution, on-board data processing and encryption functionality.

Earth observation is becoming increasingly important to help us better understand our planet and address environmental and societal issues. However, collecting and processing data from space currently faces obstacles. For example, it takes a long time, sometimes several days, to obtain information. In addition, the images are not always very accurate, showing only coarse details of about a kilometer in size, and capturing the invisible part of the light is very costly with current technologies.

New optical systems using spatial light modulators offer a solution. Developed and tested as part of the EU's SURPRISE project, they capture data from space more accurately. The three-and-a-half-year project, which concluded in June, combined research and development with stakeholder engagement and dissemination activities to ensure successful exploitation of the project's research results.

Fraunhofer Institute for Photonic Microsystems IPMS contributed its long-standing expertise in the field of spatial light modulators to the project. The institute's main tasks were to prepare a feasibility study and development roadmap for the first spatial light modulator (SLM) fully developed in Europe that can also be used in space. Fraunhofer IPMS also supported the SURPRISE partner in the development of a demonstrator. "Fraunhofer IPMS' spatial light modulators consist of thousands or even millions of individual movable mirrors, each only a few micrometers in size. The main challenges here were the space capability of all components and the coverage of a broad spectral range from the visible to the mid-infrared. In addition, innovative on-board data processing and encryption capabilities are required. This will enable even better earth observation data in the future," says Sara Francés González, a scientist at Fraunhofer IPMS.

Editor

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The innovative "Compressive Sensing" (CS) technology was used in the project. It allows the acquisition of a planar image with a single-pixel detector. This is particularly interesting for the mid-infrared range, where no suitable 2D detectors are available. At the same time, CS offers advantages in processing large amounts of data and in native data encoding. Using spatial light modulators, variable image patterns can be generated at high speed. These patterns are superimposed on the observed scene and recorded by single pixel detectors.

2022, a SLM of the latest technology generation from Fraunhofer IPMS, has successfully passed a test under space conditions. The 256 x 256 pixel device was evaluated in particular with regard to temperature (from -40 °C to 80 °C), vacuum (< 10-5 mbar) and vibrations in the X, Y and Z axes. Not a single pixel failed. These experimental results, together with the simulation results, confirm the robustness of the Fraunhofer IPMS spatial light modulators and encourage further activities for the development of a space-specific SLM technology.

By introducing for the first time the concept of a payload with medium spatial resolution and near-continuous hourly repetition, the results of the SURPRISE project can lead to a significant breakthrough in Earth observation and complement existing operational services. This concerns, on the one hand, fire monitoring and ocean color monitoring.

At the end of the project there was also a SURPRISE for children. Together with the scientist Sara Francés González from Fraunhofer-IPMS, a [video](#) was created explaining earth observation and micro mirrors used in space.

About Fraunhofer IPMS

Fraunhofer IPMS is one of the leading international research and development service providers for electronic and photonic microsystems in the application fields of intelligent industrial solutions and manufacturing, medical technology and health, and mobility. In two state-of-the-art clean rooms and with a total of four development sites in Dresden, Cottbus and Erfurt, the institute develops innovative MEMS components and microelectronic devices on 200 mm and 300 mm wafers.

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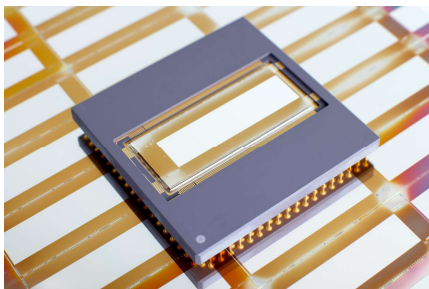
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Mirror array with one million individual mirrors
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Satellite for earth observation
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Scientist Sara Francés González of the Fraunhofer IPMS
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