# CRL Succeeded in Image Capturing Experiments Utilizing Terrestrial Equipment

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The Communications Research Laboratory (CRL) succeeded in image capturing experiments during the Micro-OLIVe mission, using terrestrial off-the-shelf equipment on the Micro-LabSat-1 launched in December 2002.

The CRL has been studying the possibility of developing an in-orbit satellite maintenance system. Rescuing a satellite once it has been launched is very difficult. Because we can only obtain information about a satellite by telemetry from the satellite itself, we cannot obtain any more information about a satellite once it has failed. Furthermore, space debris reentering the atmosphere is becoming a significant problem because the number of satellites is increasing. Therefore, we are currently studying the technologies needed to create an orbital maintenance system (OMS) for a rescue satellite to inspect satellites, to remove unneeded satellites, and to repair failed ones.

Image processing technologies such as target recognition and target ranging using images are essential to achieving OMS. OMS vehicles need to not only recognize a target but also to avoid corrosion autonomously. To create autonomous on-board image processing, developing high-performance processors and software technologies is essential. The Micro-OLIVe mission was planned as a means of demonstrating the performance of hardware equipment for image processing in OMS, such as high performance on-board computers and cameras, and software technologies to achieve high autonomy.

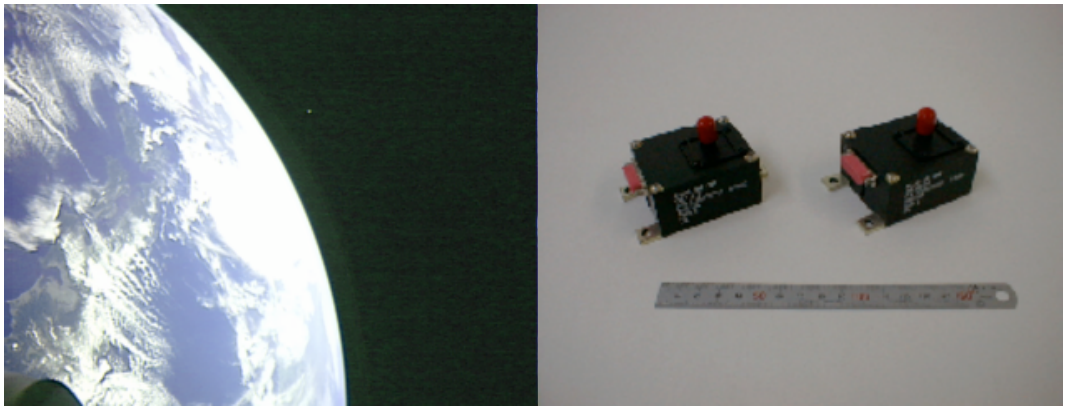
Microprocessors and digital cameras for ground systems have been vastly improved in recent years, especially for the game and amusement markets. However, the microprocessors for space use have not been greatly improved because they need to work in a severe space environment and must also be extremely reliable. If the microprocessors that are popularly used on the ground could be used in space and demonstrate a high performance level, the costs of on-board systems would be greatly decreased.

Against this background, CRL has developed a microprocessor multi-chip module to control the OMS, including its robotic system and image processing. The module is a multi-chip module (MCM) and includes a 64-bit RISC processor that is conventionally used in games and printers. The processor performance level is about 100 MIPS and 10 MFLOPS, which will greatly improve its calculation capabilities. For the program and tentative data area, we employ a 2 Mb memory equipped with automatic error correction, and an additional 4 Mb memory is provided for the image processing work area.

Energy consumption is one of the most important concerns in a space system, which makes the use of a C-MOS imaging unit in such systems advantageous because of its low power consumption. CRL has designed and developed a C-MOS imaging unit that consumes only about one-tenth the energy of a CCD imaging unit. To date, however, C-MOS imaging units have not been widely used in space systems.

CRL has also developed camera units for use within a conventional C-MOS digital still camera. This camera consumes much less energy than a CCD camera, and its cost is also kept low because only slight modifications are made to the units. During the micro-OLIVe mission, two C-MOS camera modules, which were developed by modifying a conventional digital still camera, were also tested in space, and their feasibility for space application was demonstrated.

Efficient utilization of terrestrial technologies is essential for cost and risk reduction of space systems. Accordingly, we will use the above-described equipment to perform experiments on such image processing technologies as target recognizing and tracking, in cooperation with NASDA, NAL and Tokyo University.



Captured Earth Image

CMOS Cameras Used in Micro-OLIVe Mission