Role of omnidirectional vision in space research

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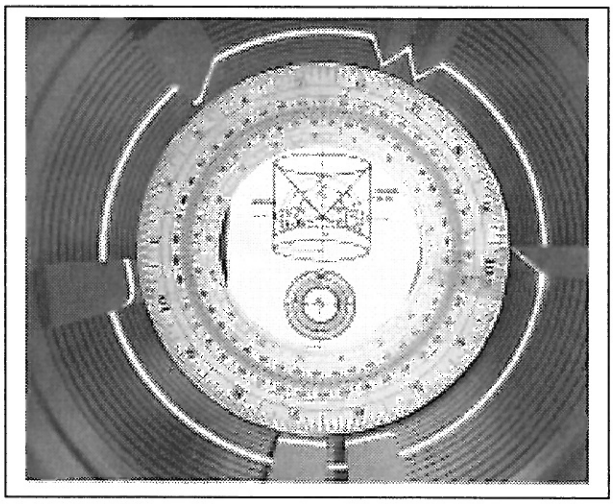
The first application of omnidirectional vision in space research, to our best knowledge, was the development of the so-called *radial profilometer* for panoramic cavity inspection (Gilbert et al. 1987). It is capable of contouring or measuring deflections on the inner surface of a cavity in 360° without the need for turning the optic around its axis. This is achieved by illuminating the internal surface of the cavity in such a way that the illuminating beam traces out a circular ring on the inside of the cavity. This light trace is captured by the PAL, and any deviation from the circular shape indicates inclusion amd/or intrusion, i.e., the profile of the inner surface of the given cavity is visualized in a panoramic way.

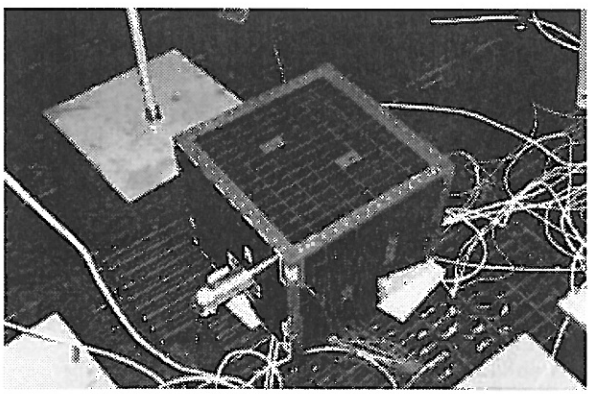
ATTITUDE DETERMINATION SYSTEMS

The idea that a virtual image of the Earth limb and a star may be formed in a PAL and projected via an imaging lens onto a target of a CCD camera led to the proposal of former students at the *University of Alabam in Huntsville (UAH)* to develop an attitude determination system for their microsatellite of a diameter of 40 cm, called SEDSAT-1.

Since namely the radius of curvature of the Earth is known, the position and attitude of the satellite can be computed relatively easily from the annular PAL image. This technique was given recognition by NASA in 1989 and was proposed for publication as a NASA Tech Brief.



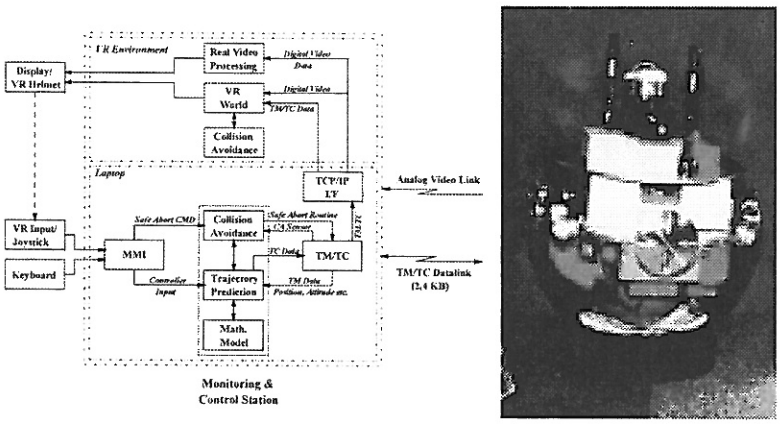
This PAL-based attitude determination system, called PALADS, was successfully launched to orbit on October 24, 1998, as a part of the Deep Space-1 Program.



Microsatellite SEDSAT-1, equipped with PALADS in the testing chamber

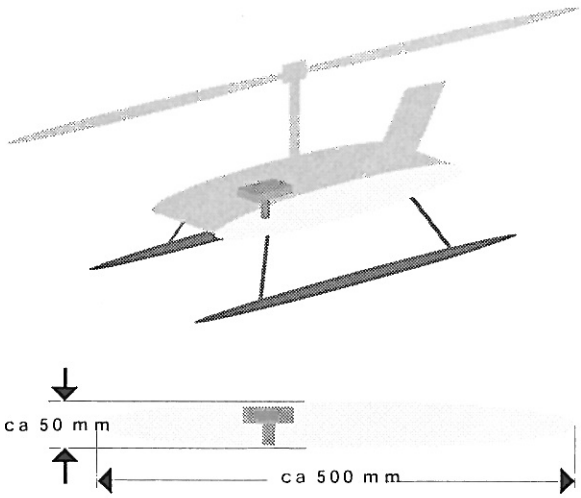
FREE FLYING ROBOTIC MICRO-SPACECRAFT

To perform inspection, monitoring and EVA support tasks outside the International Space Station (ISS), the European Space Agency (ESA) has selected, within the frame of "Free flying micro operator (FFMO)" program, the MicrOs free-flying robotic micro-spacecraft that is under development at Daimler-Chrysler Aerospace, Raumfahrt Infrastruktur (DASA-RI). The DASA-RI experts implemented a PAL-based machine vision system, a modified version of PALADS, in their MicrOs model. The system was designed and delivered by OPTOPAL Panoramic Metrology consulting.

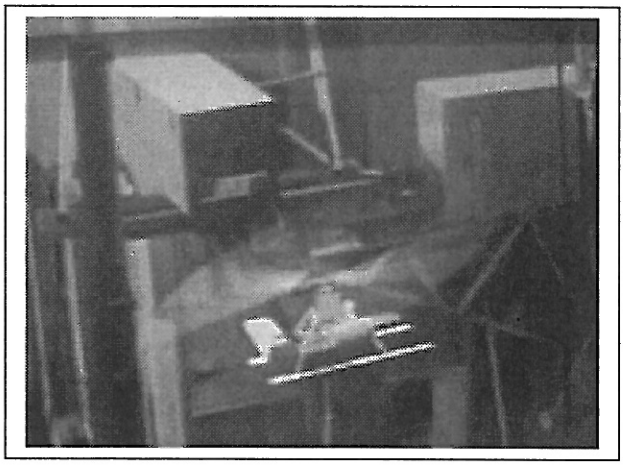


Free-Flyer MicrOs equipped with PAL Vision Module PAL-EQUIPPED MANTA

MANTA is an acronym for Mars Nano Technology Aeroplane, which is a project of the European Space Agency (ESA). As a matter of fact, it is a small autogiro with a blade diameter of about less than 1 meter. The *Institute for Aerospace Technology of the Hochschule Bremen* received the task to develop a vision system compatible with nanotechnology. Getting inspiration from MicrOs they decided to try to use a PAL-based solution. OPTOPAL Panoramic Metrology Consulting designed and delivered such a miniaturized vision module, and, at present, the MANTA mock-up is being tested in the wind tunnel.



MANTA layout with PAL-based vision module



MANTA moch-up in the wind tunnel