MULTISPECTRAL SCANNER (MSS), ERTS-1

Joseph Arlauskas

The multispectral scanner is presently in orbit on the ERTS-1 spacecraft. The MSS permits simultaneous imaging in three visible bands and one near-infrared. The images from these bands provide much of the data necessary for management of the earth's environmental resources. This data is being presented in the form of a 185-kilometer swath on the earth with a resolution of approximately 80 meters. The isometric cutaway view in Figure 1 illustrates the configuration of the MSS.

The optical image of the earth is reflected by the scanning mirror into the double-reflector telescope type optics. The scanning mirror is oscillating at a 13.6 Hz rate and provides the crosstrack scan along the orbital path.

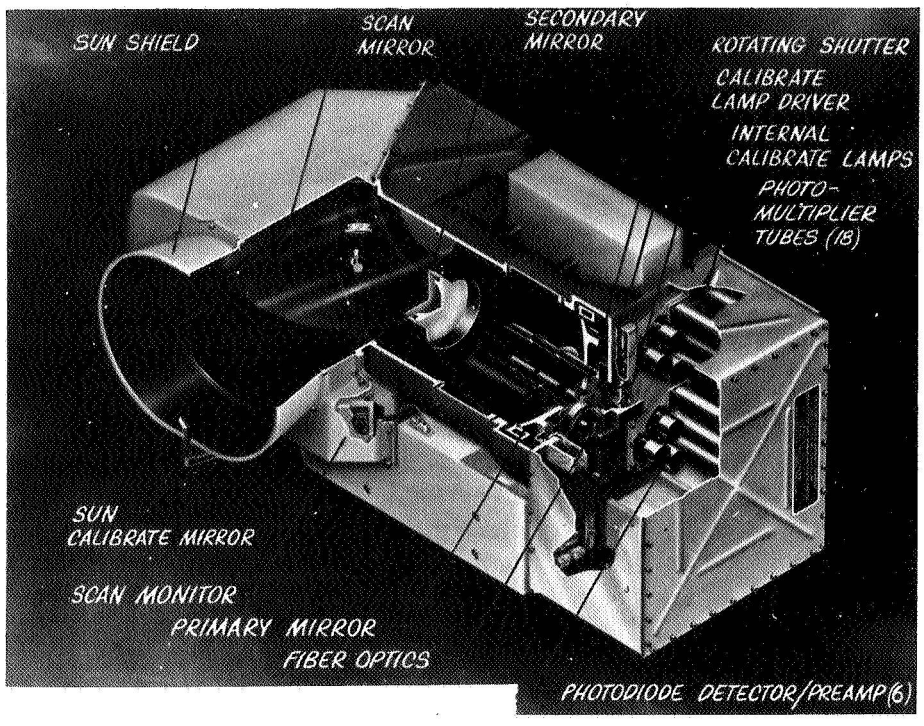

Figure 1. The four-band multispectral scanner (MSS).

There is a four-by-six fiber optics array positioned at the focused area of the telescope. This array transfers the optical image to the 24 detectors, six photomultiplier tubes (PMT) per visible band, and six silicon photodiodes (SPD) for the near-IR band.

Figure 2 summarizes the optical image transfer from the earth to an electrical signal from the detectors. The image of the earth in the 185-kilometer swath is swept across the fiber array and appears in the form of six lines/band/scan. As the spacecraft advances at orbital velocity and the scanning mirror oscillates, the next scan is swept across the swath at precisely the correct instant and provides continuous coverage along the orbital track.

The twenty-four analog detector outputs are digitized and multiplexed into a 15 Mbps stream and transmitted from the spacecraft.

During alternate retrace cycles of the scanning mirror, an internal calibration signal provides a method of equalizing gain changes that may have occurred in the six channels of one spectral band. A sun calibrate signal is also provided once each orbit as an alternate means of calibration.

The complete subsystem dissipates approximately 65 watts and weighs 54.4 kilograms.

The results of the multispectral scanner are shown in Figure 3, a color composite image of the Baltimore-Washington area taken on September 23, 1972. Three bands were combined to construct this composite. Healthy plants and trees which are very bright in the infrared are shown as bright red. Suburban areas with sparse vegetation appear as light

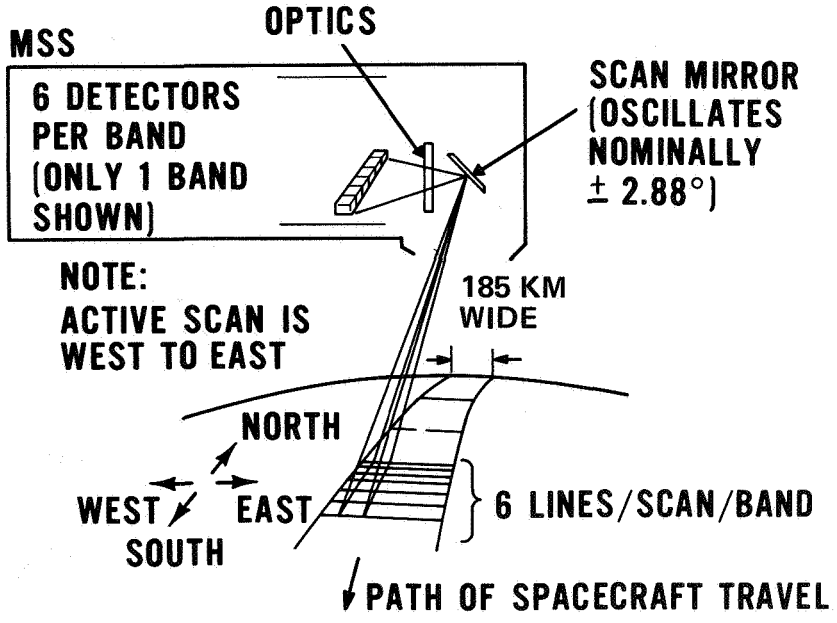

Figure 2. MSS ground scan pattern.

pink, and barren land as light gray. Cities and industrial areas show as green or dark gray and clear water is black/dark blue. Some of the geographical landmarks are:

- Washington, D.C.
- Baltimore
- Chesapeake Bay
- Jet contrail
- Patuxent Naval Station
- Dulles Airport
- I-95, 70-N, Baltimore-Washington Parkway

Analyses of typical scenes indicate that resolution is on the order of 80 to 90 meters for small targets and 50 meters for extended targets such as roads, rivers, and bridges.

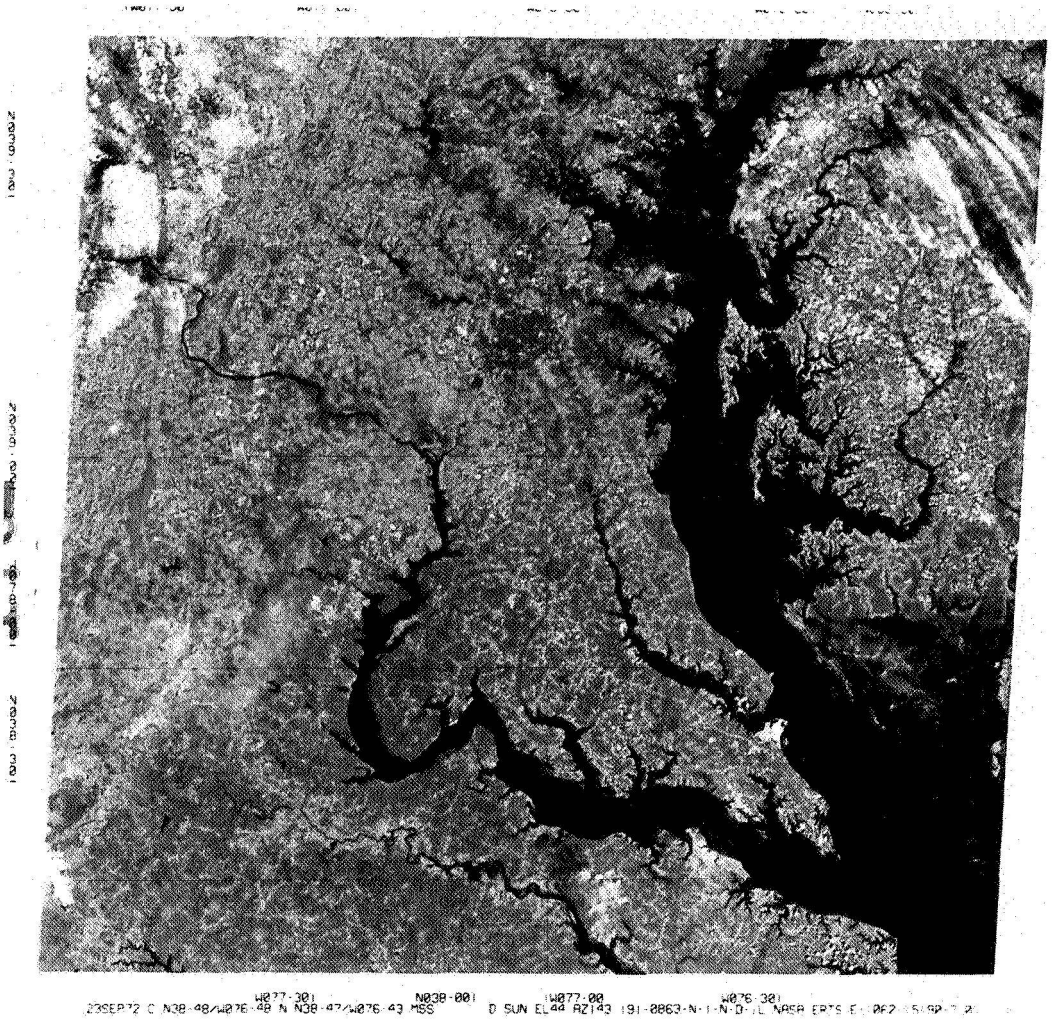

Figure 3. Baltimore-Washington scene. Source: NASA ERTS E-1062-15190 color composite. Original in color: can be ordered from EROS Data Center, Sioux Falls, S.D. 57198.