MULTISPECTRAL IMAGE DISSECTOR CAMERA SYSTEM

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The ERTS spacecraft will provide multispectral images via two sensors, the Return Beam Vidicon Camera (RBV) system and the Multispectral Scanner (MSS) system. The RBV system requires three individual cameras to obtain data in three spectral channels. Unless the cameras are perfectly bore-sighted and completely identical in all respects, misregistration between images will result which can only be corrected by elaborate ground processing techniques. The MSS on the other hand requires a complex oscillating scan mirror and six detectors in each of four spectral channels to obtain adequate signal to noise ratios. Because of these disadvantages, an effort was made to develop a sensor system which would provide registered high-resolution multispectral images from a single sensor with no mechanical moving parts.

Figure 1 shows how the Image Dissector Camera (IDC) system operates. An Earth scene 100 nautical miles wide is imaged through a single lens onto a photocathode surface containing three spectral filters, thereby producing three separate spectral signatures on the photocathode surface. An electron image is formed and is accelerated, focused, and electromagnetically deflected across an image plane which contains three sampling apertures, behind which are located three electron multipliers.

The IDC system used electromagnetic deflection for cross-track scanning and spacecraft orbit motion for along-track scanning, thus eliminating the need for a mechanical scanning mirror. Because a single lens and electrooptical system are used, registration is assured with simple "X" and "Y" positioning of the write beams in the ground processing equipment.

Table 1 shows a comparison of data obtained with an engineering model and lens system in the lab and with the RBV system. As noted, the IDC has achieved 3400 TVL resolution as compared to 4000 for the RBV. This small difference will likely vanish in final picture processing because of the ease of registration with the image dissector. A 3 to 8 dB improvement in S/N with the RBV system is noted. This is not as great a difference as it first seems. In the RBV system, the signal output is generated from the returned portion of the electron beam scanning the photocathode; hence, as signal input goes down, return beam current goes up, resulting in increased noise. This causes S/N to decrease at a faster rate than is normally associated with reduction in signal level. In the IDC, the exact opposite occurs. As the signal input goes down, so does the photomultiplier current, reducing the noise level, and hence, the S/N does not decrease as fast as that dictated by normal signal level reduction. This results in picture quality that does not suffer as much from the lower S/N seen in the IDC. Excellent quality is seen in pictures taken with values of S/N typical of those which would be achieved with an orbital camera system. It will be an important experiment to make pictures of identical scenes with both the RBV system and the IDC and allow potential users to evaluate the relative merits of the resulting imagery.

In conclusion, the IDC system is lighter in weight, smaller in volume, simpler in electronics and mechanics, simpler in ground processing equipment required, and, most importantly, considerably cheaper than existing multispectral image systems intended for use in the ERTS mission.

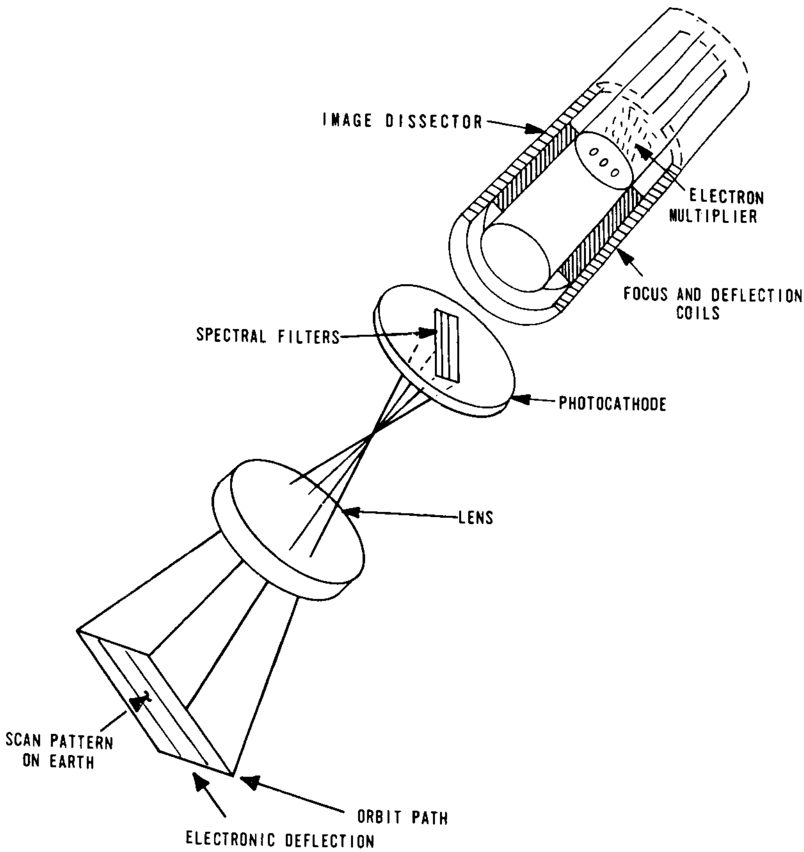

Figure 1–Schematic diagram of the IDC system.

Table 1—Performance of the IDC and RBV systems.

System	Tube Resolution (TVL)	In-Laboratory System* (TVL)	S/N Ratio (dB)		
			Channel 1 (475-575 mm)	Channel 2 (580-680 mm)	Channel 3 (690-830 mm)
IDC	3400 @ 25% mod.	3400 @ 5% mod.	25	23.8	22
RBV	4500	4000	33	33	25

*Lens and camera with scene having 40% reflectance and contrast ratio 6:3 to 1.