a scan in the bidirectional mode with display statistics equivalent to those produced in 15 min in the unidirectional mode would then be 210 min.

Alternatively the bidirectional scan comprising 50 lines if done at 100 cm/min would take 12½ min. A space constant of 0.05 cm would then demand a time constant of 0.03 sec. If a unidirectional scan was done at 500 cm/min, the maximum speed the machine allows, it would take only 5 min but would still be far better than the bidirectional scan since a time constant of 0.1 sec could be used for a space constant of 0.8 cm.

One can generalize and say that it is always possible to obtain a scan of given display statistics in a shorter time by unidirectional scanning than by bidirectional scanning. The reason for this is that bidirectional scanning demands the use of space constants about an order smaller than the dimensions of the features one is interested in resolving. This imposes a loss in real time which is much greater than that due to the silent "fly-back" periods of unidirectional scanning. If this were more generally understood, bidirectional scanning would soon become a thing of the past. It is true that the argument presupposes that the display is dependent upon the ratemeter output and is not under the influence of individual detected pulses. However, no disadvantage is attached to this.

It should also be mentioned that scalloping can be avoided by means other than unidirectional scanning. For example, the whole display can be shifted at the end of each scan line to offset the spatial lag due to the use of long time constants. However, such systems suffer the disadvantage that the distortions consequent upon the exponential nature of the analog ratemeter response, remarked upon by Simmons et al (*2*), occur in opposite directions in successive scan lines. Although these distortions are still present in unidirectional scans, the fact that they occur always in the same direction allows one to employ larger space constant values than would otherwise be the case.

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THE AUTHORS' REPLY

In the example presented by Sear and Dean, a very important factor in rectilinear scanning is overlooked; viz., count density (counts/cm^2). The authors state that it would take 210 min to get a bidirectional scan with equal display statistics as one produced in 15 min using unidirectional scanning. While this may be true if one considers only the statistical uncertainty in the ratemeter signal, the overall statistical validity of the scan depends strongly on the total number of photons detected as well. In the example cited, the bidirectional scan would have a count density 16.7 times greater than that of the unidirectional scan. Thus one could hardly call the two scans statistically comparable. The fact is that it is not possible to obtain a unidirectional scan in the same amount of time as a bidirectional scan with the same count density.

In an earlier publication (*1*) Sear and Dean state that the time lost in returning the scanning head to its starting position in unidirectional scanning is compensated for by increasing the scan speed. The authors further state that the decrease in count density that results from the increased scan speed is more than offset by the increased statistical accuracy afforded by the longer space constants. However, no analysis is offered to prove the latter statement.

There is no question that for equal count densities unidirectional scanning is superior to bidirectional scanning because of the offset between scan lines in bidirectional scanning. However, we believe it is not justified to say that a unidirectional scan can be obtained in less time than a bidirectional scan of equal statistical validity.

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