

TELEVISION SIGNALS AND SCANNING PATTERNS

PREAMBLE

A recent note in IEEE Spectrum (August 1986, p26) recalls to mind an idea which occurred to me many years ago. I have never seen it discussed in print - but that could be either because I rarely read the sort of publication in which such a discussion might appear, or because the idea is self-evidently stupid to anyone who really knows about the subject. Or it might just be that no one else has thought of it; and it is with that thought in mind that I proceed. Comments are solicited.

The Spectrum note commented on the asymmetry of the conventional raster used for television pictures, and its effect on the presentation of lines which run nearly horizontally or vertically across the screen. A vertical line can be shown quite precisely; but a line close to the horizontal must be represented by slow changes in intensity of the raster lines, and is much harder to show clearly.

My idea is - if I may say so - brilliant in its simplicity. Why not scan both ways alternately ?

THE IDEA.

Well, that's really all there is to it. First you scan with a horizontal raster, which will show sharp vertical lines but blunt horizontal ones; then you scan with a vertical raster, which shows blunt vertical lines and sharp horizontal ones. I would expect that the eye would catch hold of the sharp information, in much the same way as it handles sharp line drawings with blurred colours, when what you actually see is a sharp picture with sharp colours. Even if it doesn't, the sharp transition will be displayed, so the definition of the otherwise blunt lines should be improved (and, conversely, the definition of the otherwise sharp lines will be poorer - but at least it'll be symmetrical). Lines in intermediate directions will be affected to an extent which depends on their inclination; lines at 45° to the horizontal will presumably be more or less unchanged. (I'm assuming a square picture; make appropriate adjustments throughout for a rectangle.)

INFORMATION THEORY, SORT OF.

If we really are going to get a sharper picture, we must be moving more information around somewhere. It isn't obvious that the video signal from such an interleaved raster will be of different bandwidth from the more common pattern; so any increase in information rate must be achieved within the same bandwidth.

Consider for purposes of argument that we are transmitting a static picture. (Except for sudden changes of scene, successive frames of a television picture are unlikely to be very different, so this assumption is probably not a bad first approximation.) The video signal is cyclic, with frequency equal to the frame repetition frequency; Fourier analysis will give the frequency spectrum as a set of lines separated by the frame repetition frequency from zero to the upper limit of the available bandwidth. Devices such as interlacing do not affect this picture very much, as the two signals corresponding to the two sorts of frame are quite closely related - you can approximate one as an average of two slightly displaced (by the time for one line scan) versions of the other, and the correction signal is likely to be comparatively small.

Now consider the alternating direction raster. Now there is no simple relationship between the signals of consecutive frames - and the video signal is now cyclic with half its original frequency. This means that there will be twice as many lines in the signal's spectrum within the acceptable bandwidth; and the amplitudes and phases of the components corresponding to these new lines carry the additional information.

FLICKER ?

You might wonder whether the rather strange scanning pattern would be expected to lead to unacceptable flicker in the displayed picture; if you think of the times between successive illuminations of extreme corners of the screen, it is clear that the patterns differ greatly over the picture. I don't know the answer; but one might hope that any such effect could be minimised by modifying the suggested procedure to rotate the raster through 90° at each frame instead of alternating between two directions. Would that help ? I don't know that either - but it sounds like a reasonable thing to try. (I don't think it affects the "analysis" of the previous paragraph at all.)