Letters to the Editor

Note: Readers are invited to comment on any article published in the SMPTE Journal. *Such comments should be addressed to the Editor, SMPTE Journal, 862 Scarsdale Ave., Scarsdale, NY 10583.*

Re: "High-Resolution TV for the Production of Motion Pictures" by Louis L. Pourciau, published December 1984, pp. 1112–1120

The following correspondence has taken place regarding the above-mentioned paper:

January 23, 1985

Dear Editor:

I read Mr. Louis Pourciau's article "High-Resolution TV for the Production of Motion Pictures," from the December 1984 issue of the *Journal*, with great interest. Unfortunately there are a number of erroneous assumptions and conclusions evident in this article which I feel need to be brought forward.

1. The analysis was based on a motion-picture aspect ratio of 1.66:1. This aspect ratio is not used in North America. It is used occasionally in Europe.

More importantly this analysis does not address the very common 1.85:1, CinemaScope/Panavision, or 70mm formats. As these formats are very important, they cannot be ignored. Some of the major motion pictures of the last several decades were filmed and exhibited in the latter two of these formats, e.g., the *Star Wars* trilogy, the Indiana Jones films, *Dr. Zhivago*, *2001*, *Lawrence of Arabia*, *The Bridge Over the River Kwai*, *Victor/Victoria*, and *Starman*, to name but a few.

Any attempt to use video for motion-picture production must address all the preferred formats, not just an uncommon one that happens to conform to a Japanese proposal for high-definition television.

2. The analysis fails to mention several impairments unique to video. In suggesting that video can be a viable replacement for a motion-picture camera, all the impairments should be laid out. Television cameras suffer from lag, especially in low light, and comet-tailing. The vertical sampling inherent in television will give rise to moiré patterns wherever there is fine vertical detail in the picture.

3. The analysis assumes a two or three times picture height viewing distance in the theater. The majority of seats in modern theaters are much closer than two or three picture heights. This means that the scanning line structure will be quite visible to a large number of the theater patrons. This is clearly a retrograde step in motion-picture exhibition.

Spot wobble could be used to help hide the line structure, but at the cost of reduced vertical resolution.

4. The analysis assumes only one VTR in the TV/film system. This is unrealistic. One of the main reasons for considering video for production is the ease and relative speed of editing videotape. As all motion pictures require editing, provision must be made to allow for this. This must be allowed for by including a second VTR or by assuming that the *RGB* separations must be mechanically conformed (a very messy, expensive, and unlikely process).

5. The analysis does not adequately address the problem of noisy blacks in video. Directors and directors of cinematography are quite adamant about good, strong, uniform blacks in their films. It seems unlikely that the creative community will suddenly give up their concerns in this area. While black clipping and black compression can hide much of the noise, this is done at the expense of losing much black detail.

6. In the analysis it is not clearly specified where in the system the 6 dB of vertical aperture correction is added. Also the VTR noise is characterized as "flat channel plus 6-dB aperture correction . . ." It is not clear what this means. Normally an FM carrier-type VTR has anything but a flat noise spectrum as there usually is a rise in the low-frequency noise spectrum as well as the high. In any event, there should be more data on the proposed VTR so that its noise contributions could be more knowledgeably applied and understood.

7. In the analysis no allowance is made for the loss of resolution that will result when the electron-beam recorder *RGB* separations are exposed and then printed onto the internegative. The loss of resolution is due to the registration problems that inevitably occur when three separate exposures are made onto one frame. Tolerances such as 0.05mm occur in the film perforation tolerances. One cannot assume a perfect adherence to the nominal film tolerances, no shrinking or swelling of the film, and perfect registration by the printer movement.

8. The use of a Schneider Xenon as the camera taking lens is not realistic. This lens is designed for CCTV and will not cover the 1.66:1 35mm format. In general CCTV camera lenses are not as well corrected as motion-picture taking lenses. For an analysis such as this, typical motion-picture lenses such as those of Panavision or Zeiss should be used.

9. The use of a $B_{ambient}$ to a B_{max} of 1.5% is not realistic with modern lenses. While Schade speaks of 1.5% in his analysis made in the early 1950s, current lenses can do much better than this. A colleague has advised me that considerably less than 1.5% ambient is present in most modern theaters. I suggest that actual measurements be made instead of using 30-year-old data that happens to fit conveniently into the author's hypothesis.

In general, the paper in question seems to pass over various relevant details without adequate exposition, e.g., where is the TV signal *RGB*, and where is its *YIQ* (*YUV*), what are the noise bandwidths of the color difference channels, is the VTR component or composite, and so on.

In a paper such as this with such potentially far-reaching implications, the need for clear, detailed exposition cannot be overemphasized. Every detail and assumption must be fully set forth and justified.

While I am still studying this article and will continue to do so, I did want to point out these items as soon as possible to hopefully stimulate a robust and useful discussion.

Yours truly,
R. Evans Wetmore, P.E.
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In a letter dated March 18, 1985, the author makes the following rebuttal:

The following is a point-by-point response to Mr. Wetmore's comments regarding my article in the December *Journal*. I have taken the liberty of sending a copy of this letter to Mr. Wetmore.

1. Aspect ratio and other formats. I doubt that I could have picked one aspect ratio that would have satisfied everyone. It should be noted that the paper *compared* two systems, and I do not think the results would have been appreciably affected by the use of another ratio such as 1.85:1. It should be noted that an aspect ratio of 5.33:1 has been recommended recently as a production standard. This is fairly close to the 5:3 ratio I used in my analysis.

I am afraid because of the limitations of time and energy I must continue to ignore 70mm, 65mm, Imax, Showscan, etc.

2. Video impairments. I think everyone in the motion-picture business and TV business who might be interested in the results of my work are aware of the problems inherent in the use of television. My point, which I made several times in the course of the paper, was to make an objective comparison of signal-to-noise ratio, resolution, and contrast ratio of the two systems described in the paper.

3. Viewing ratio and scanning line visibility. At a recent demonstration of the capabilities of high-resolution TV as applied to motion pictures in a very high-quality theater in San Francisco, we marked off the theater seating in screen heights. We found row B to be one screen height away from the screen, row K two heights, row S three heights, and row Z four heights. I noted that the audience, consisting of very critical technical types, settled themselves between 1.5 and 3 screen heights away from the screen. And this for very critical viewing. In my experience only a very small portion of the audience positions itself less than 1.5 screen heights away from the screen. Closer positioning often makes for back and neck pains. In any case, remember that this is a comparison between two systems.

In order for scanning lines to be visible at the screen, the limiting resolution of that portion of the system following the EBR would have to exceed 1860 TV lines (930 active lines and 930 spaces). I have not "done the sums," but from inspection of the responses involved and from recent demonstrated results, I do not believe this to be the case.

4. Editing and multiple generation tapes. As in motion-picture practice, it is always wise to minimize the number of generations between the original and the release media. It is probably true that more than one tape generation would be needed in actual practice, just as more generations would often be needed in the all-film system. In the case of the TV/film system, I doubt very much that more than two generations would often be needed. In any case, since the controlling noise for the TV system is the camera, a second or even a third generation tape would have very little effect on the overall system signal-to-noise ratio. It would have no effect on resolution, since the frequency response can be made flat to the highest frequency of interest, while adding a film generation would have a significant effect on resolution. It should be noted that we are cascading many processes in both systems, and a small change in any one will have negligible effect on the whole system. I should note that I have assumed that the actual editing decisions would be made off line with a scan converted signal.

5. Noisy blacks. I think the problem of noisy blacks is more than adequately expressed by Fig. 11 of the paper and the related text to be found on pages 1119 and 1120. In the last two sentences in the article I say, "In fact, the black SNR is so poor that it would be found objectionable. Thus the all-film system using 5294 film would provide significantly better performance than the TV/film system using presently available camera tubes under the same light levels."

6. Vertical aperture correction and VTR noise spectrum. The vertical aperture correction is assumed to be applied in the camera video processor, although I do not think it matters very much.

The assumed videotape recorder noise spectrum is essentially that shown in the article entitled "Quadruplex Video Noise and Measurement Techniques" by Richard W. Elliott of 3M, published in the November 1974 issue of the *SMPTE Journal*. Note specifically Fig. 7a on page 889. As can be seen from the figure, the rise in noise at low frequencies represents a very small part of the total noise energy.

7. Loss of resolution in printing EBR separations. Perhaps I should have added one printer step here. This would reduce the response of the TV/film system by about 10% at 800 lines. That is from about 6% to 5.4%.

8. Lens resolution. As pointed out on the first page of the paper, the camera lens selected as an example of potential performance has an excellent center MTF, comparable, in fact, to the best motion-picture lenses, and better than most, according to data recently obtained. In any case, I am *comparing* the performance of the two systems, and the same lens MTF is used in each. The performance of the lens is, of course, more critical in the case of the TV system because of its smaller image size. The coverage of the lens is not material since I have considered only center resolution.

9. Ambient screen illumination. I stand by my assumption of projection lens flare plus theater ambient illumination being 1.5% of peak highlight brightness until proven wrong by actual field measurements. Lens flare alone is of course less than this. Again I am *comparing* two systems and the same 1.5% is used in both.

10. Various relevant details. The use of separate *RGB* signals is assumed with either a three- channel recorder or three separate recorders interlocked. A prototype three-channel recorder of more than adequate bandwidth and signal-to-noise has been developed and privately demonstrated. The use of color difference signals is not recommended.

I am sorry my exposition was not sufficiently clear and detailed. I can only plead exhaustion. After all, the paper did run on for some nine pages.

I very much appreciate Mr. Wetmore's detailed examination of my paper and his comments, and look forward to hearing more from him. However, I do slightly object to being accused of using data to fit my hypothesis, since I had none. The results were as much a surprise to me as they are evidently to Mr. Wetmore.

Best regards,
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