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TECHNICAL INSTRUCTION
P.3

Waveform Distortion and Correction

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SECTION 1

VERTICAL APERTURE DISTORTION

Introduction

Aperture distortion is a loss in resolution caused by the use of a scanning beam of finite size[1,2,3]. This loss in resolution appears as a reduction in the amount of fine detail visible in a picture and is most noticeable on a resolution wedge of converging black and white lines. Horizontal resolution is the ability of the system to reproduce vertical transitions in the picture and vertical resolution is the ability to reproduce horizontal transitions.

Reduction of aperture distortion in both the horizontal[4] and vertical directions can be effected by the addition of a signal derived from the distorted signal. This correction signal enhances transitions in the picture but has an average value of zero so that it does not change the background tone.

Reduction of Aperture Distortion

Horizontal aperture distortion can be reduced by a high-frequency lift[1,4,5]. In this instance the correction signal is the additional high-frequency components. However, vertical aperture distortion is a function of the change in signal at corresponding points in adjacent television lines. A process approximating to a high-frequency lift in the vertical direction can be achieved by taking the difference signal between successive lines[2,6].

In Fig. 1.1(a) the brightness (dotted line) of a thin vertical strip in a television picture in the region of a horizontal transition is shown in terms of the brightness of corresponding points in successive lines (solid vertical lines). Figs. 1.1(b) and 1.1(c) show the same waveform advanced and delayed respectively by one line duration.

The correction signal, Fig. 1.1(d), is obtained by adding these three components in the proportions 1: $-\frac{1}{2}$: $-\frac{1}{2}$. These proportions ensure that there is no correction signal except in the region of a horizontal transition. Fig. 1.1(e) shows the corrected waveform formed by adding a chosen amount of the correction signal to the original waveform. This gives both a faster transition and overshoots both of which increase the subjective picture sharpness.

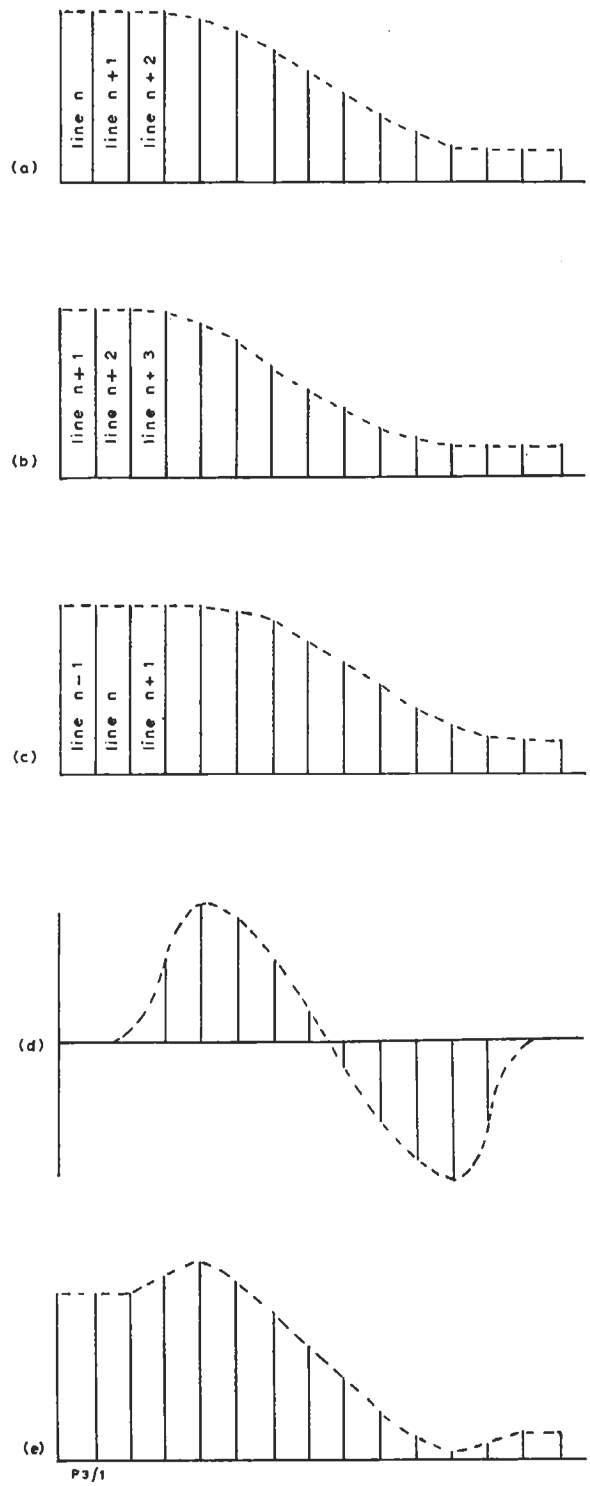

Fig. 1.1 Diagram Illustrating the Technique of Vertical Aperture Correction

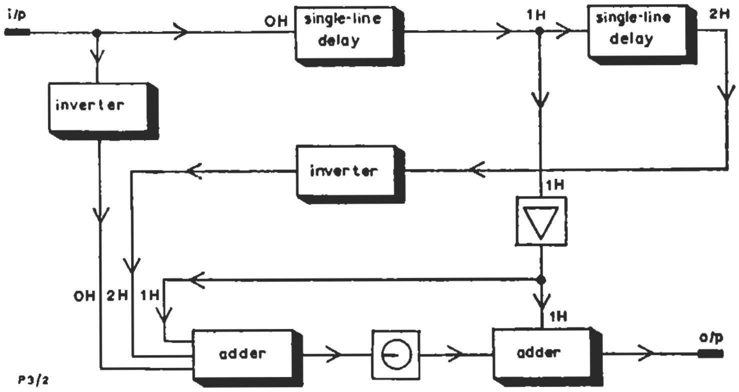

Fig. 1.2 Block Diagram of a Vertical Aperture Corrector with Two Single-line Delays

Double-delay Vertical Aperture Corrector

Fig. 1.2 shows the block diagram of a vertical aperture corrector which uses two single-line delays to produce the signals described above[7]. The main signal is the input signal delayed by one line (1H). The correction signal is formed by adding the components 0H, 1H and 2H in the proportions $-\frac{1}{2}:1:-\frac{1}{2}$. The amount of correction is taken as the ratio of the 1H signal component at the output of the corrector with correction to the amount of 1H signal component without correction.

Single-delay Vertical Aperture Corrector

Fig. 1.3 shows the basic block diagram of a vertical aperture corrector which uses only one single-line delay[8]. The 0H component of the output signal is obtained from the circulating network. The 1H component is obtained from the single-line delay. Circulation of the output signal to the input of the delay enables a 2H component to be obtained. It also provides, by further circulation, unwanted components at 3H, 4H, 5H and so on. The circulating network can be arranged so that the wanted components occur in the output signal at the correct relative amplitudes and that the unwanted components occur at amplitudes that can be ignored. In general this restricts the amount of correction that can be used before a form of ringing occurs on the corrected picture.

A block diagram of a practical type of single-delay vertical aperture corrector is given in Fig. 1.4. In this type of corrector the amplitude of the 1H component in the output signal is constant and therefore the output level varies with the amount of correction.

This disadvantage is overcome in a second type of single-delay vertical aperture corrector shown in Fig. 1.5. This type of corrector also has the advantage that the amount of correction is controlled by a single attenuator and this enables a noise-reducing circuit to be inserted at the point marked X.

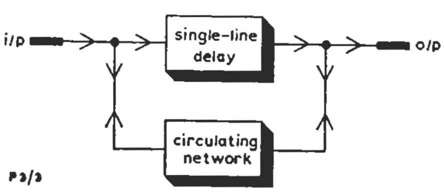

Fig. 1.3 Basic Block Diagram of a Vertical Aperture Corrector with One Single-line Delay

Noise

Noise voltages are uncorrelated on successive lines of a picture and so vertical aperture correction degrades the signal-to-noise ratio of a video signal. Two methods can be used to reduce this degradation[9]. The correction signal can be limited in bandwidth to eliminate high-frequency noise degradation or the correction signal can be passed through a non-linear amplifier which removes low-level signals by clipping. Both these methods require a small additional amount of delay in the direct signal path to compensate for the delay introduced by the noise-reducing device.

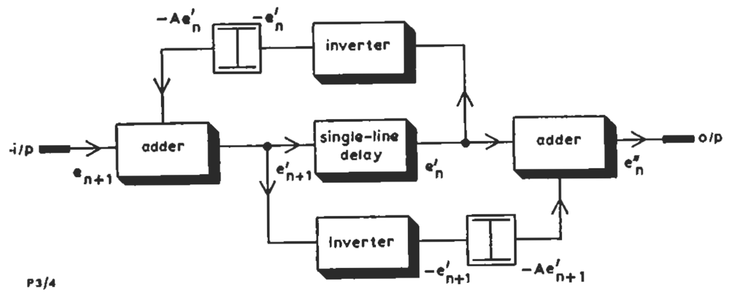

Fig. 1.4 Block Diagram of a Practical Corrector with One Single-line Delay

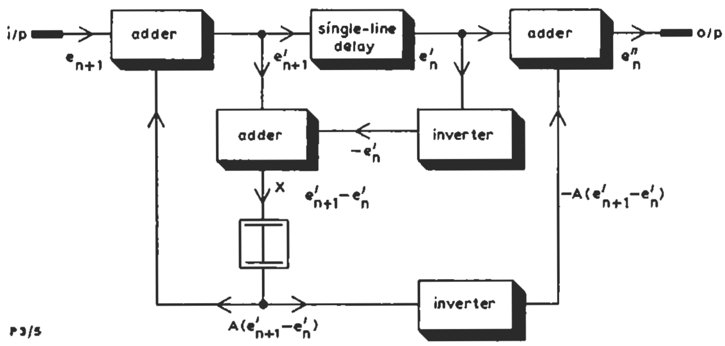

Fig. 1.5 Block Diagram of a Corrector with One Single-line Delay and which Requires Only One Attenuator

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