



Principles of operation of video encoders and decoders in the production domain

EBU Sub-group G4

(Video origination equipment)

This EBU TUTORIAL has been prepared within the framework of an Ad-hoc Group of EBU Sub-group G4 (Video origination equipment). It deals with the basics of conventional PAL and SECAM encoding and decoding equipment which is now widespread in EBU Members' production facilities.

1. General considerations

1.1. Definitions

A PAL or SECAM *encoder* can be regarded as a “black box” transforming primary input signals G, B, R (possibly Y, G, B, R) or component input signals Y, C_B, C_R or Y, P_B, P_R into a composite PAL or SECAM signal.

It is a “bridge” between the world of primaries or components and the composite PAL/SECAM world.

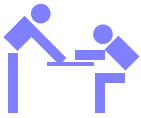
A *decoder* performs the inverse function, i.e. it is a “black box” which transforms a composite PAL or SECAM signal at its input into component or primary signals at its output.

1.2. Historical background

In the very early days of colour television (1950's in the United States), the encoder, being a complex component, was virtually unique in the chain and located at the studio output. Inside the studio, signals were processed (mixed, etc.) in their component or primary form (three signals). In view of the complexity of this method, the encoding of these three signals into a unique composite signal at the video signal source was soon adopted. Each source (camera, telecine, etc.) was then equipped with its own encoder and studio signal processing was done in composite form. This simplified matters considerably. For a long time in studios, at least for PAL and NTSC systems, the signal from a source was encoded once and for all, with the decoder being placed in the receiver. With SECAM systems, the signals have to be decoded before passing into a mixer.

In recent years, more and more television studios were equipped with “islands” operating with analogue or digital component signals. These “islands” contain analogue or digital component recorders, and/or digital component processing systems (special effects devices, graphics systems, etc.) according to CCIR Recommendation 601.

A camera signal, encoded in PAL or SECAM at the source, has to be decoded at the input of such an island and re-encoded in PAL or SECAM at the output of it, especially in order to be distributed in the composite



network. In some cases, these decoding/re-encoding operations can be multiple, which can quickly give rise to quality-related problems.

The only way to avoid such multiple operations would of course be to have signal sourcing, processing and distribution in component form.

Basic definitions of “encoder” and “decoder”, as understood in the modern production studio environment, are given in the box below.

1.3. Classification of encoders and decoders according to their functions

The considerations in *Section 1.2.* lead us to separate the encoders in two functional classes:

a) *Source encoder or system encoder*

This is the encoder at the signal source location.

b) *“Secondary” encoder or re-encoder*

This is the encoder at the output of any equipment in the chain which processes the signal in primary or components form (for example, digital special effects). Such encoding allows continued transmission of the signal in the television composite chain.

Similarly, two classes of decoders can be defined:

a) *Final decoder or display decoder*

It is located in the receiver at the end of the television chain and supplies component signals destined for screen display only (these signals will therefore never be processed and re-encoded).

b) *Studio decoder*

This decoder is located in the production chain, assumed to be essentially composite. It supplies component signals to any processing device working in a primary or components standard. These component signals are destined to be re-encoded after processing for continued transmission in the chain.

Considering the complete video signal chain, end-to-end, the following combinations can arise:

- encoder *a* + decoder *a*
- encoder *a* + decoder *b* + encoder *b* + decoder *a*, where the central combination (decoder *b* + encoder *b*) may in some cases be repeated several times.

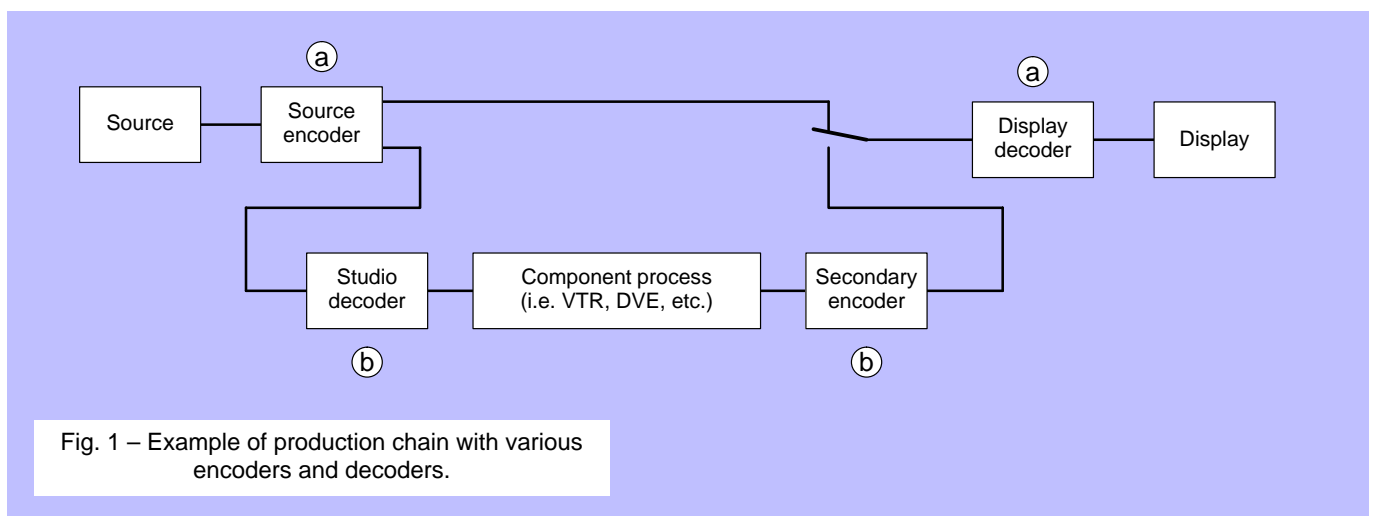


Fig. 1 – Example of production chain with various encoders and decoders.



2. Decoding problems and types of decoders used

2.1. Areas of application for decoders

In programme production one can consider the following areas of application for decoders:

- a) Conversion of composite PAL/SECAM signals into analogue component signals (analogue component recorders, analogue studio apparatus, down-stream chroma-key, etc.).
- b) Conversion of composite PAL/SECAM signals for processing by digital component equipment (digital special effects, digital video graphics, digital component video tape recorders, timebase correctors, synchronizers, etc.).
- c) Transfer of pictures from magnetic tape (composite signals) to film (primary signals).
- d) Conversion of composite PAL/SECAM signals to MAC or other component transmission signals.
- e) Conversion of composite PAL/SECAM signals to component formats suitable for bit-rate reduction.

2.2. Decoding problems

The decoding problems can have several origins:

- the specific original encoding of the television system;
- the decoder itself;
- the threshold for adaption (in the case of adaptive decoders);
- the distortions due to composite signal processing (multi-generation recording in particular) and signal transmission prior to decoding.

Adaptation essentially changes the decoding mode, depending on picture content.

2.2.1. Problems due to the system

PAL/SECAM encoding involves the frequency multiplexing of the luminance spectrum with that of the two chrominance signals. This provokes three important effects during decoding:

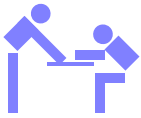
- intrusion of high-frequency luminance into the chrominance (cross-colour)
- intrusion of the chrominance into the luminance (cross-luminance).
- reduction of the chrominance signal pass-band in the horizontal direction. For SECAM there is also a reduction in the chrominance signal pass-band in the vertical direction.

2.2.2. Faults due to the decoder itself

Depending on the processes used in the decoder, the output signals may have certain faults (loss of resolution in various directions, severity of cross-effects dependent on decoder type). In addition, the quality of decoding will depend on the precision and stability of the dematrixing, filtering and delays. Also, certain “artefacts” may be created. The quality of these parameters has a large influence, especially where a number of codecs are connected in cascade.

2.2.3. Problems of threshold for adaption

The problems relating to the establishment of the threshold conditions at which adaption takes place are very complex. A change to a different decoding mode can correct a defect or fault but will often create new impairments. The use of suitable test signals can facilitate the setting of threshold.



2.2.4. Faults due to signal processing or transmission

There are a variety of distortions caused by the processing (recording in particular) and transmission of composite PAL or SECAM signals which can create errors during decoding. These show themselves on the following parameters:

- frequency response;
- phase response;
- differential gain;
- differential phase;
- intermodulation and noise.

2.3. Types of decoders

As the inter-leaving of the luminance and chrominance spectra constitutes the major problem arising with composite signals, the decoders differ principally in the methods they use to separate them. The method used governs the decoding quality. The following methods are found:

- a) Separation by low-pass or notch filters (luminance) and band-pass filters (chrominance). These introduce filtering in the horizontal spatial frequency of the image (loss of definition on vertical edges).
- b) Separation by line-delay comb filters. These introduce two-dimensional filtering (loss of definition on diagonal edges).
- c) Separation by field comb filters. These introduce filtering in the vertical and temporal domains.
- d) Separation by frame comb filter. These introduce filtering in the temporal domain.

For methods *b*), *c*) and *d*) these comb filters may have a so-called “adaptive” mode in the sense that, depending on the *content* and/or the *movement* of the picture, the comb filter may be modified to an alternative comb or a horizontal filtering.

There are however problems associated with the detection and processing of the adaptation control signals, in respect of establishing the threshold of operation and also the mode of insertion, to prevent introduction of new and unwanted distortions.

2.4. PAL decoders

2.4.1. Decoder with horizontal filters (conventional decoder)

a) General description

To separate the luminance and chrominance a low-pass or a notch filter is used for the luminance and a band-pass filter for the chrominance.

Demodulation of the chrominance after this separation uses either the “simple” PAL or “delay-line” PAL method.

“Simple” PAL

In this process the chrominance signals obtained after separation are demodulated directly on the U and $\pm V$ axes.



As regards distortions due to processing and transmission, this form of demodulation leads to:

- variations in the saturation and U/V crosstalk if the high-frequency amplitude is not transmitted correctly;
- the appearance of coloured horizontal bars at line frequency (known as “Hanover bars”) if there are phase or differential phase errors. This phenomenon is perceptible when the phase errors exceed 5° (particularly evident in the magenta) or if the burst phase is incorrect.

The characteristics of the Y, U and V signals after demodulation are:

- full vertical bandwidth for chrominance and luminance
- horizontal luminance bandwidth reduced if a horizontal filter is used for separation.

“Delay-line” PAL

In this process the chrominance signals are first separated into U and $\pm V$ using a one-line delay, and then demodulated, each according to its respective axis U or $\pm V$.

For distortions due to processing or transmission we have:

- variation in the saturation if the high-frequency amplitude is not transmitted correctly;
- phase errors and differential phase have the effect only of reducing the saturation, to an extent proportional to $1 - \cos \beta$, where β is the phase error. This system therefore survives large phase errors without hue errors and without appreciable loss of saturation.

The signal characteristics after demodulation are:

- chrominance signal bandwidth reduced by half in the vertical direction (3 dB at 78 c/ph, zero at 156 c/ph);
- colour flickering on sharp horizontal chrominance edges;
- cross-colour reduced by up to 3 dB (depending of the picture contents);
- no crosstalk between the U and V signals (for horizontal frequency);
- reduction of noise in chrominance channels (theoretically 3 dB).

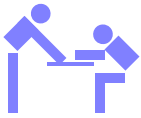
b) Characteristics

Owing to the system of separation using so-called “horizontal” filters, this type of decoder suffers from cross-colour and cross-luminance, and has reduced luminance bandwidth in the horizontal direction. It also may have reduced horizontal chrominance bandwidth, dependent on the kind of chrominance band-pass filter.

The severity of these effects depends on the characteristics of the filters used, although it is impossible to eliminate them entirely. Also, an improvement in one effect is generally accompanied by a degradation in the other (for example, less cross-luminance implies less horizontal luminance bandwidth). Depending on the choice of chrominance demodulation method, further attributes or shortcomings are added.

2.4.2. Decoder with line-delay comb filter (vertical filtering)

This type of decoder should have an adaptive mode of operation.



a) *General description*

In the fundamental approach the chrominance is separated from the luminance with a comb filter comprising two one-line delays. To obtain the chrominance the direct signal is subtracted from the delayed signal, whilst the luminance is obtained by adding the direct signal to the 2-line delayed signal (alternatively the chrominance is subtracted from the composite signal delayed by one line).

Demodulation of the chrominance uses either the simple PAL or delay-line PAL process.

b) *Characteristics*

Compared to conventional decoders with horizontal filters, this type of decoder with vertical comb filtering gives the following improvements and impairments:

- cross-colour is suppressed but only for details with pure horizontal spatial frequency;
- cross-luminance is reduced for the horizontal spatial frequency and is introduced for the vertical spatial frequencies (without adaption mode);
- the luminance resolution for horizontal spatial frequencies is improved (stationary and moving images);
- the luminance resolution in the diagonal direction is reduced;
- there is a reduction of chrominance resolution in the vertical direction. This can appear as hue errors.

c) *Introduction of the adaptive mode*

Adaptive operation involves detecting the colour transitions for high vertical spatial frequencies, which cause cross-luminance and hue errors, and reverting to the pure horizontal filters in the luminance and chrominance channel.

Several realisations of line comb filter decoders with an optional adaptive mode are now commercially available.

2.4.3. Decoder with field-delay comb filter (vertical-temporal filtering)

This type of decoder may have an adaptive mode (motion detector and transition detector for the vertical spatial frequency).

a) *General description*

The preferred form of field-delay comb filter is realised as follows:

To obtain the chrominance, use is made of a comb filter (or transversal filter) containing two quasi-field delays (312-line fields). A half-amplitude signal with one-field delay is taken, and from this is subtracted a quarter of the sum of the direct signal and a signal delayed by two fields. The luminance signal is obtained by subtracting the chrominance signal from the PAL (also valid for SECAM) signal delayed by one field.

Chrominance demodulation uses either the simple PAL or delay-line PAL process. Switching between these processes may depend on the mode of operation of the decoder and of the adaption.

b) *Characteristics*

This type of decoder has the following characteristics:

- cross-colour from purely horizontal spatial frequency can be totally suppressed. Temporal information introduced in this form of picture will reduce cross-colour suppression;



- cross-colour is only reduced for diagonals consisting of high horizontal frequencies and low vertical frequencies;
- cross-luminance is inserted for horizontal coloured edges; it extends over two lines for still pictures, and more for moving pictures;
- some loss of diagonal luminance resolution is present but it is not so severe as that of line-delay comb filter;
- on moving pictures loss of detail (blurring) will occur.

c) *Adaptive mode*

If the adaptive mode is included, the field-delay comb filter is changed to either the line-delay comb filter or to the pure horizontal filter. For the impairments see the corresponding paragraphs of *Sections 2.4.1.* and *2.4.2.*

2.4.4. *Decoder with frame-delay comb filter (temporal)*

This type of decoder always has an adaptive mode.

a) *General description*

The basic principle of separating the luminance and the chrominance is as follows: half the sum of the direct signal and the signal delayed by two frames is subtracted from the signal delayed by one frame to give the chrominance. The luminance is derived by subtracting this chrominance from the PAL (also valid for SECAM) signal delayed by one frame.

b) *Characteristics*

This type of decoder has the following characteristics for stationary images or those exhibiting only very slight movement:

- no cross-colour;
- no cross-luminance;
- no reduction in horizontal, vertical or diagonal luminance resolution.

With moving pictures cross-colour appears again and also cross-luminance patterns appear at moving coloured edges, accompanied by hue errors.

c) *Adaptive mode*

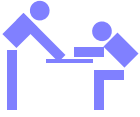
For stationary pictures temporal comb filter is used. For moving pictures another form of filter must be used. This alternative filter may be of the field-delay, line-delay comb or pure horizontal filter type. The selection of the modes and the switching from one mode to the other are a function of the motion and picture content.

This type of decoder at present exists only in the form of laboratory prototypes.

2.4.5. *Decoder with temporal comb filter plus motion prediction*

This type of decoder is under development.

It will modify moving images by means of motion prediction to a form for which either field or frame comb filtering can be used. This system would require the real-time production of a large number of motion vectors.



2.5. SECAM decoders

2.5.1. Decoder with horizontal filters

a) General description

To separate the luminance and chrominance, low-pass and band-pass filters are used for the luminance and chrominance respectively.

b) Characteristics

The output signals from this decoder will suffer from cross-colour and cross-luminance. These effects may be reduced through the use of adequate separation filters, but never eliminated. The luminance bandwidth (in the horizontal direction) will be reduced to approximately 3 MHz.

Also, the bandwidth of the chrominance in the vertical direction will be halved (characteristic of SECAM).

With regard to processing and transmission errors, the SECAM system is not very susceptible to the frequency and phase responses, or to differential phase and gain.

2.5.2. Decoder with comb filter

The CCETT has developed a decoder using a comb filter, although no such equipment is yet available on the market.

a) Description of system

The decoder incorporates temporal filtering with an adaptive mode for separation of the luminance and chrominance. One-field delays and a contour corrector are used. The SECAM signals are digitized with 13.5 MHz sampling and 9-bit coding. This decoder can also process a PAL signal.

b) Characteristics

For fixed images the cross-colour and cross-luminance are eliminated, especially in fine horizontal details (vertical resolution) and in details that are slightly oblique with respect to the vertical. For details in the horizontal direction (vertical resolution), or slightly slanted with respect to this direction, *a posteriori* detection of distortions helps to maintain optimum characteristics in the decoded signals.

2.6. Use of digital composite signals

All the decoders mentioned above can be built for digital PAL or SECAM signals. Such signals are in fact obligatory in decoders using field or frame stores.

By using digital signals in decoders (and in encoders) the stability and precision of all processing such as dematrixing, filtering and demodulation could be improved. Many of the problems currently found are due to the decoder itself and these could be largely eliminated by digital solutions.

For digital PAL decoders there is a choice of sampling frequency. The simplest decoder implementation, and the one giving highest precision of U and V separation, employs sampling at a multiple of sub-carrier frequency, $4f_{sc}$. A limitation arises with non-standard PAL signals, and interpolating filters are required to interface the decoded components to digital systems conforming to the sampling scheme defined in CCIR Recommendation 601.

Other PAL decoders may use the standard line-locked sampling frequency of 13.5 MHz (Recommendation 601). Such designs are more complex, in particular for the recovery of the subcarrier from the line-locked sampled composite signal. Such designs may function with non-standard signals and will have a direct component digital interface.



3. Re-encoding problems and types of re-encoders used

3.1. Re-encoding artifacts

When re-encoded into composite form, the signal loses fidelity in two respects:

- passband of chrominance signal;
- band sharing spectra of luminance and chrominance.

To remedy these artefacts, special precautions need to be taken.

3.1.1. Chrominance signal passband

CCIR Report 624–4 specifies the following limits for the horizontal passband of chrominance signals (U and V in PAL, D_R and D_B in SECAM):

- attenuation < 3 dB at 1.3 MHz
- attenuation > 20 dB at 4 MHz in PAL
- attenuation > 30 dB at 3.5 MHz in SECAM (without allowing for base pre-correction)

CCIR Recommendation 601–1, in its Appendix 1, attributes the following chrominance filtering characteristic:

- attenuation < 0.5 dB for $0 < f < 2.7$ MHz
- attenuation > 6 dB for $3.37 < f < 4$ MHz
- attenuation > 40 dB for $f > 4$ MHz

The filter for digital encoding of PAL/SECAM signals is therefore much wider than the basic filter for encoding in PAL/SECAM (source encoder).

The PAL/SECAM characteristics for the chrominance passband are given by the source encoder.

For re-encoding (encoder *b* in Fig. 1), the chrominance filter described in Recommendation 601–1, Appendix 1 is recommended in order to avoid a filter cascade effect and all unnecessary loss of horizontal chrominance definition.

It follows that for further decoding and re-encoding operations, use of the Recommendation 601 chrominance filter is also recommended, as a means of avoiding further filter cascade effects as above.

To make sure that the signals to be re-encoded have previously been decoded, some identification of signal history must be transmitted (see Section 3.2.).

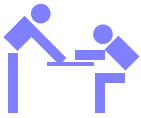
3.1.2. Band-sharing of the luminance and chrominance spectra

The inability of current decoders to fully separate chrominance and luminance signals gives rise to cross-signals (cross-colour and cross-luminance).

If a PAL or SECAM signal, after decoding, is *directly* re-encoded using a *subcarrier with the same frequency and phase* as the original and the *same phase for V axis switching*, cross-colour and cross-luminance due to decoding will not further impair the picture quality.

On the other hand, if the decoded component signals are processed (as in the case of video effects, still store etc.) such that the original subcarrier frequency and phase are modified, then interference will be created during re-encoding which may be very troublesome.

In the case of a still store for example, a subcarrier residue in the luminance channel will be “frozen”. During encoding of the reproduced still, this “frozen” residue will interfere with the subcarrier which fol-



lows the 8-field sequence. The result will be very severe chrominance flicker. An insufficient reduction of 20 dB of the subcarrier in the decoder will cause a 3 dB peak-to-peak flicker and 11° peak phase jitter of the subcarrier. To reduce both these forms of interference to non-troublesome values of 0.2 dB peak-to-peak and 1°, the subcarrier suppression in the decoder must be at least 40 dB. For a precision decoder the subcarrier suppression must be specified at 46 dB.

In video effects systems using component signals, a slight change in picture size or a slight rotation can also cause similar interference.

This explains the need to equip studios with high-quality decoders. It is moreover necessary to re-encode component signals with a subcarrier having the *same phase* as the original subcarrier. This means that the PAL 8-field sequence must be preserved. Thus, for example, the editing of component signals originating from composite signals will have to be done with an 8-field and not 2-field resolution if the aforementioned type of interference is to be avoided.

For these reasons, it is necessary for component signals originating from a decoder to contain auxiliary information, as outlined below.

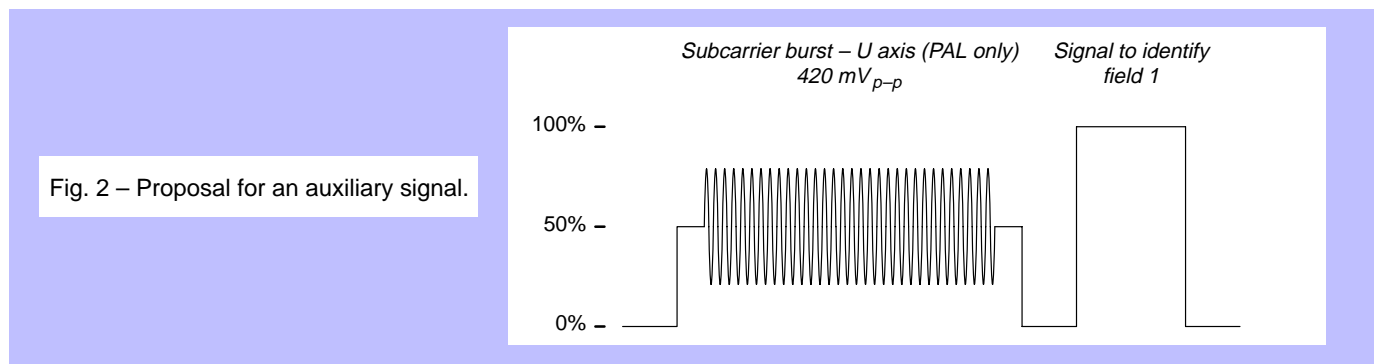
3.2. Use of auxiliary signals for assistance in re-encoding

Information on the history of the signal can be provided by auxiliary data, to be added to the component signals. The information should be the following:

- the original signal standard (PAL or SECAM);
- the position of the field sequence (4 fields for the SECAM system, 8 fields for PAL);
- the absolute phase of the original subcarrier (for PAL only).

If the auxiliary information is absent, this means that the signals are of “component” origin.

It is proposed that future studio decoders should produce the signal shown in *Fig. 2* on line 22 (only valid in the studio domain) of the vertical luminance blanking interval.



The pulse would only be present on field 1. As only the signal for the PAL system contains the subcarrier burst, PAL/SECAM identification is implied.

The advantages of this proposal are as follows:

- this auxiliary signal can be recorded by digital VTRs;
- it can be implemented in a digital and analogue environment;
- it implies no major changes to analogue and digital component formats.



3.3. Use of comb filters

3.3.1. General considerations

It has been seen that the introduction of comb filters (at line, field or picture rate) in decoders can, under certain conditions, serve to reduce or suppress cross-colour and cross-luminance. To reinforce the effectiveness of this luminance and chrominance spectrum separation, it is possible to effect *comb pre-filtering* in the encoder.

The purpose of this pre-filtering is to strengthen the spectral separation between the chrominance and luminance signals before the two signals meet.

With this pre-filtering, a reduction in cross-colour and cross-luminance can only be achieved at the detriment of fine detail resolution. These losses of detail for luminance and chrominance, particularly when using 3-dimensional comb filters (horizontal, vertical and temporal) can be seen on moving sharp edges and moving fine details.

3.3.2. Type of pre-filtering

Pre-filtering involves the same techniques as those used in the decoders. Accordingly, the following options are available for encoders:

- a) no filter (general case today);
- b) horizontal filtering (notch filter in the luminance channel);
- c) vertical filtering (line comb filter);
- d) vertical-temporal filtering (field comb filter);
- e) temporal filtering (frame comb filter).

Note: For the luminance, comb filtering is done only in the frequency band from 3 to 5 (or 6) MHz.

3.3.3. Encoder-decoder pairs

With the introduction of comb filters in encoders and decoders, there may be three types of encoder-decoder "pairs", in addition to the classic combination of a no-filter encoder (possibly with notch filter) with a decoder with horizontal filters (low-pass, band-pass).

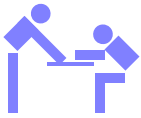
- a) encoder with no filter – decoder with comb filter;
- b) encoder with comb filter – normal decoder (horizontal filters);
- c) encoder with comb filter – decoder with comb filter.

3.3.4. Characteristics of encoder-decoder pairs

- a) *Encoder with no filter – decoder with comb filter*

This combination is becoming more and more common. The characteristics are described in *Sections 2.3.1. and 2.3.2.*

This combination allows for some reduction of cross-colour and cross-luminance and an increase in the luminance resolution (compared with the conventional decoder).



This combination is also beginning to appear for the basic television chain (source encoder + display decoder), as receivers with comb filter decoders have just appeared on the market.

b) *Encoder with comb filter – conventional decoder*

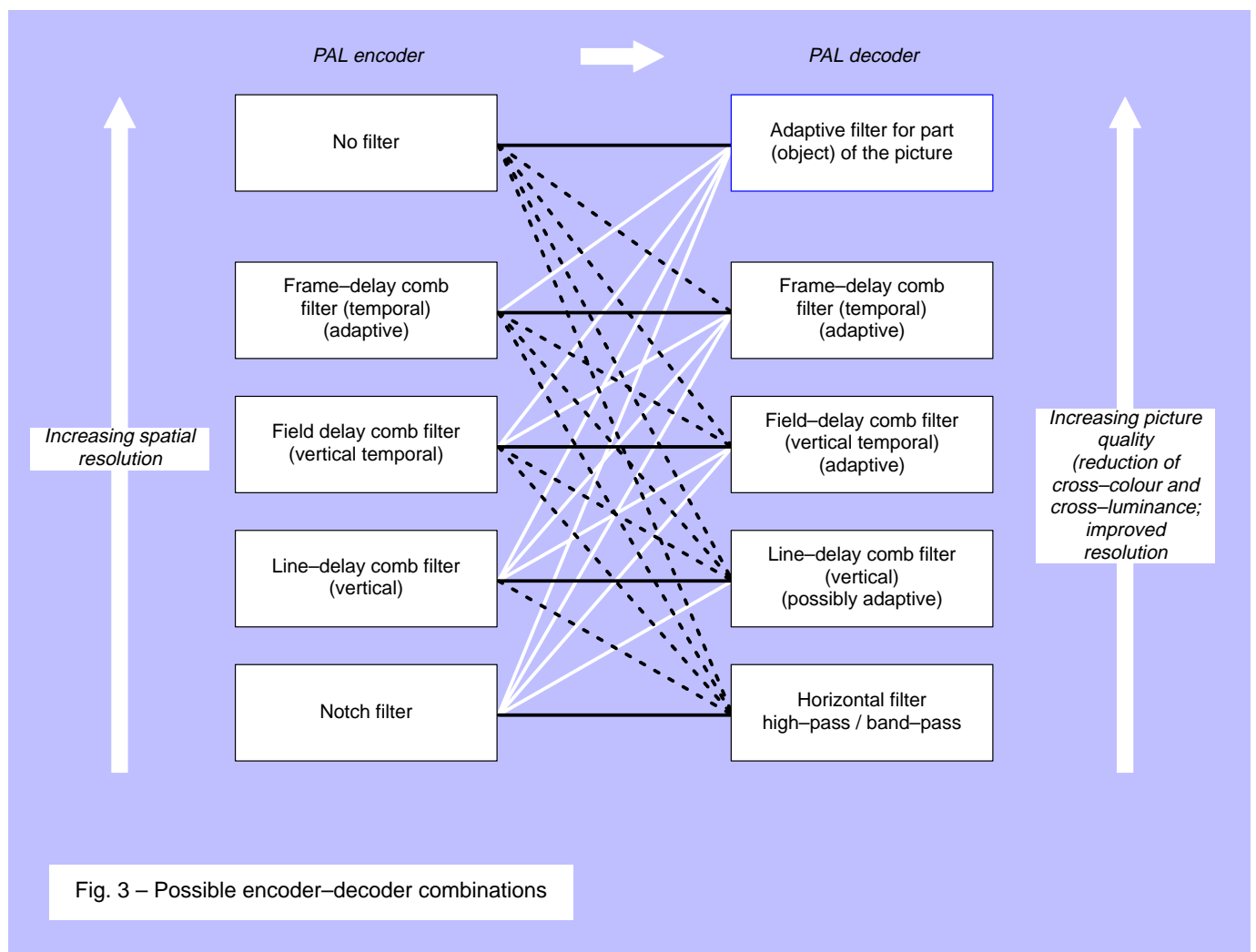
This combination raises the problem of compatibility for the introduction of the comb filter into encoders. Pre-filtering in the encoder introduces a reduction of cross-colour, especially at a coarse level. The reduction in cross-colour is nevertheless achieved at the cost of a reduction of the luminance resolution, although this should not be a serious problem since the luminance resolution was previously masked by the cross-colour.

There nevertheless remains a problem with this encoder-decoder pair in the form of a certain reduction of the vertical and temporal chrominance resolution which is greatly dependent on the filtering. It is therefore necessary to choose with care.

c) *Encoder and decoder with comb filter*

As mentioned earlier (*Section 3.3.1.*), this combination introduces a better reduction in cross-colour and cross-luminance, although this necessarily implies a reduction in the resolution. The best compromise is achieved when the pre- and post-filtering is matched, that is to say, when the same type of comb filter is used in the encoder and the decoder.

Fig. 3 illustrates, for PAL systems, the different characteristics of various encoder-decoder combinations.





Summarising, the best compromise between the reduction in cross-colour and cross-luminance and preservation of resolution is provided by the encoder-decoder combinations linked in *Fig. 3* by horizontal lines.

The encoder-decoder combinations shown in *Fig. 3* with broken lines give a definite reduction in cross-colour and cross-luminance which is at the more or less considerable expense of a reduction in the reproduction of details.

Combinations shown with white lines can be even more unfavorable. For example, if an encoder has a notch filter in the luminance channel, any sophisticated filtering in the decoders will be of no avail as the luminance details will already have been suppressed at source.

Certain encoder-decoder combinations can therefore give poor results.

In *Fig. 3*, the decoder framed in a blue line (possibly) represents the model of the future. It would have to use movement prediction techniques for all the moving parts of a picture.

3.4. Introduction of new filtering techniques

If the EBU were to recommend the use of a pre- and post-filtering technique in the studio domain, it would have to meet the following conditions:

- Be *compatible*, that is to say, it would have to provide better results or, at worst, identical results to those of existing codecs, for the three types of encoder-decoder combinations mentioned in *Section 3.3.3*.
- Be *unique*, thus avoiding, for programme exchanges for example, the creation of encoder-decoder combinations giving poor results (white lines in *Fig. 3*).
- Be *identical for pre-filtering (encoder) and post-filtering (decoder)* in order to achieve the best compromise between cross-colour and cross-luminance and resolution reduction (horizontal lines in *Fig. 3*).
- *Abolish the use of the notch filter in encoders*, to avoid rendering decoder comb filters ineffective as a means of increasing the resolution.
- *Introduce an identification signal in the component signals originating from studio decoders*, in order to comply with the field sequences of composite PAL/SECAM signals (see *Section 3.2*).

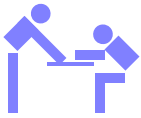
The following consequences of introducing new filtering techniques should be noted:

- The inclusion of pre-filtering in the encoder would require some amendment of the standard PAL definitions.
- The incorporation of temporal, field or frame delay comb filters introduces studio synchronization problems. This is further complicated when it is necessary to maintain synchronism of the PAL 8-field sequence.
- Compensating delays will be required for audio signals in order to maintain synchronism between vision and sound.

4. Closing remarks

The testing of encoding and decoding equipment requires signals which can provide information on all parameters which govern satisfactory translation between the component and composite parts of the chain.

A provisional list of parameters and pertinent test signals has been established by the EBU group of experts. This list is being further examined and details of amplitudes, levels and measurement methods are expected to be finalized soon.



Note: The sections of this Tutorial on re-encoding and the use of auxiliary signals were drafted when composite studio processing was the norm. In the light of the present trend towards components operations, further presentations and use of signalling may be required to eliminate unwanted bandwidth limitations. It will also be necessary to standardise on a data format for an auxiliary signal that can be incorporated into the serial digital interface. These aspects are being considered by a new Ad-hoc Group of EBU Sub-group G4 on encoders and decoders.

Video encoding and decoding equipment based on new technology (especially digital) has recently been developed. A new Ad-hoc Group has been set up to report on this new development.

Rewards for high-definition video recording and COFDM

At the opening ceremony of the 18th Montreux International Television Symposium and Technical Exhibition, a Montreux Achievement Gold Medal was awarded to Mr. D. Pommier, Director of the Centre Commun d'Etudes de Télédiffusion et Télécommunications (CCETT). The Award was in recognition of the development and promotion at worldwide level of the advanced channel coding and modulation technique known as coded orthogonal frequency division multiplexing (COFDM), which is at the heart of the Eureka 147 DAB Digital Audio Broadcasting system. The COFDM concept is being extended, again under the strong influence of the CCETT, for use in digital television broadcasting systems for satellite and terrestrial delivery.

A second Achievement Gold Medal was awarded to Mr. M. Morizono, Chairman of Sony Magnascale, for the development and introduction of the first practical analogue and digital high-definition video-tape machines. The development of these recorders has involved breakthroughs in recording technology, notably in the areas of head and mechanical design, machine electronics and tape transport systems. The remarkable progress in this field, under the guiding influence of Mr. Morizono, is seen as a landmark in the art and science of television.

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The photo shows Mr. Morizono and Mr. Pommier in the company of the Chairman of the Montreux Awards Committee, Mr. B. Pauchon.



Photo: Foster Roizen, ITVS