CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-80
1 August 1991

SOURCE : JAPAN
TITLE : CONVERSION SIMULATION BETWEEN 525 LINE INTERLACED FORMAT AND SCIF
PURPOSE : Information

....

1 INTRODUCTION

A common intermediate picture format is an attractive approach to achieve interregional visual communications in the public switched networks. In Broadband ISDN (B-ISDN), an advanced high resolution format, SCIF (Super CIF), may be defined because the current CIF defined for visual telephony will be insufficient for higher quality video services in B-ISDN.

The picture format proposed by European countries in Document AVC-29 seems a good candidate for SCIF if such progressive scan video sources and displays or VTR become widely available. However, since the current TV standards must continue to be used for rather long periods, conversion between these standards and SCIF will be required. It should be noted that degradation of picture quality due to conversion filters cannot be compensated by other means. In this document, we describe the simulation of picture format conversion between 525 line interlaced format and SCIF. The processed pictures will be presented at the tape demo.

2 CONFIGURATION OF THE CONVERSION SYSTEM

Figure 1 shows the configuration of the conversion filters. The input signal is a R601 interlaced picture having 480 active lines, 720 pels and 29.97 frames/sec. Filter #1 carries out an interlace-noninterlace conversion with 16 taps, and converts the signal to 480 active lines, 720 pels and 59.94 frames/sec. Filter #2 converts the number of lines from 480 to 576 with 9 taps and outputs SCIF signals. In this simulation, no picture coding is performed.

Through Filter #3 and Filter #4, which are the inverse filters corresponding to Filter #1 and Filter #2 respectively, the SCIF signals are converted back to R601 interlaced signals. Details of these filters are described in ANNEX. In the simulation, the original input signal and total output signal with 525-line interlaced format are compared. At the tape demo, 625-line interlaced pictures which were generated by the same system except for 625/525 conversion filters will also be shown.

3 SIMULATION RESULTS

The SNR for the "Flower Garden" sequence is 43.4dB (Y), and the SNR for the "Mobile and Calendar" sequence is 43.6 dB (Y), where the SNRs are calculated using the following formula.

$$SNR = -10 \log(E^2/255^2) \quad E^2 : \text{noise power}$$

As far as we could judge subjectively from our investigations, there are no degradations nor artifacts in the reproduced pictures.

4 CONCLUSION

A simulation has been carried out on the conversion between NTSC and SCIF picture formats proposed by European countries. SNR and subjective investigation show that there are no problems in re-converted picture quality. Further study will be required on coding efficiency and additional hardware for the approval of SCIF approach.

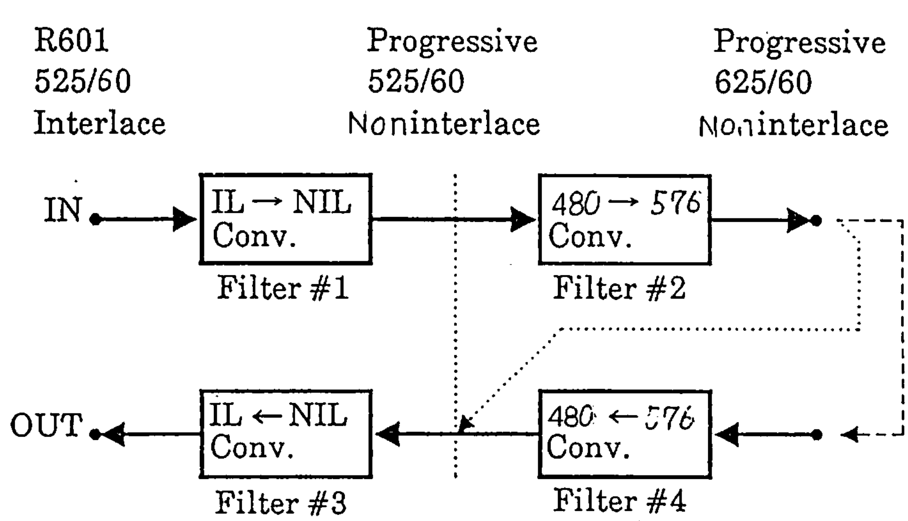


Figure 1 Configuration of the simulation system

ANNEX

1. Filters #1 and #3 : Line interpolation

(i) Lines of odd fields and even fields are interpolated as described below.

Odd fields : $P(2n+14)=\sum_{i=0}^{15} k(i)\, I(n+i)$

$P(2n+15)=\sum_{i=0}^{15} k(15-i)\, I(n+i)$

Even fields : $P(2n+15)=\sum_{i=0}^{15} k(i)\, I(n+i)$

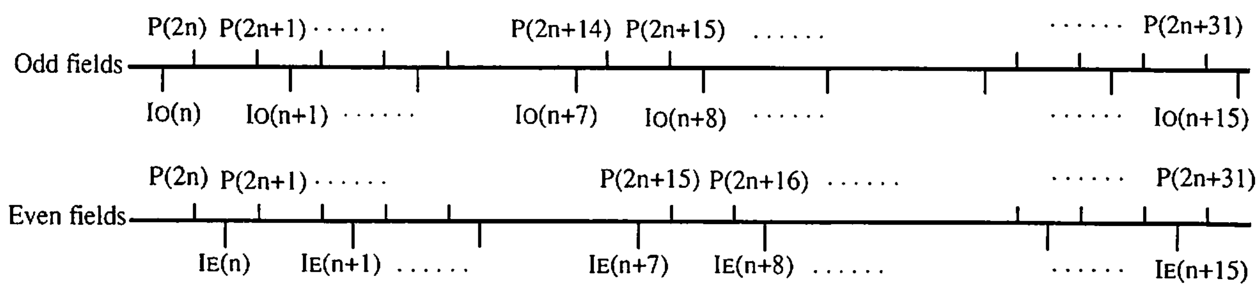
$P(2n+16)=\sum_{i=0}^{15} k(15-i)\, I(n+i)$

IO,IE : signals of the interlace fields

P : signals of the progressive frame

$n >= 0$

k(0)= -4.71275E-6	k(8) = 2.93157E-1
k(1) = 8.20019E-5	k(9) = -9.77189E-2
k(2) = -6.83349E-4	k(10) = 3.73109E-2
k(3) = 3.65793E-3	k(11) = -1.2437E-2
k(4) = -1.43503E-2	k(12) = 3.27288E-3
k(5) = 4.56022E-2	k(13) = -6.23928E-4
k(6) = -1.36807E-1	k(14) = 7.59277E-5
k(7) = 8.79471E-1	k(15) = -4.40871E-6



(ii) Inverse transform from a progressive frame to an interlaced field is as described below.

Odd fields : $I'_O(m+4)=\sum_{i=0}^{15} h(i)\, P(2m+i)$

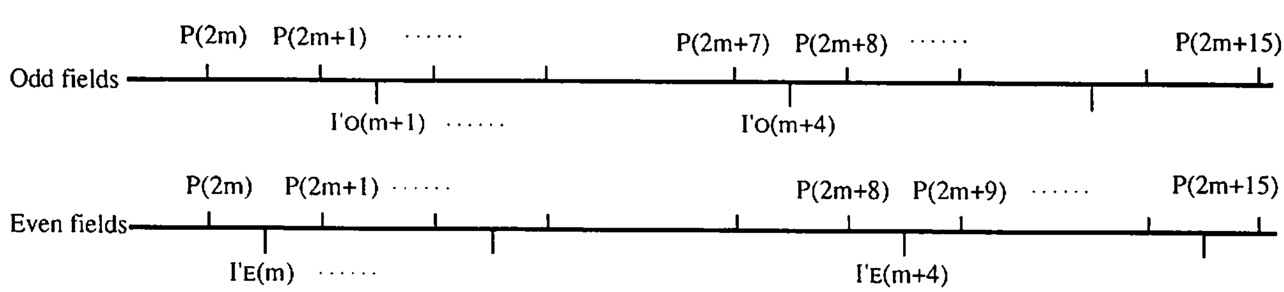
Even fields : $I'_E(m+4)=\sum_{i=0}^{15} h(i)\, P(2m+1+i)$

I'O,I'E : recovered signals of interlace field

P : signals of progressive frame

$m >= 0$

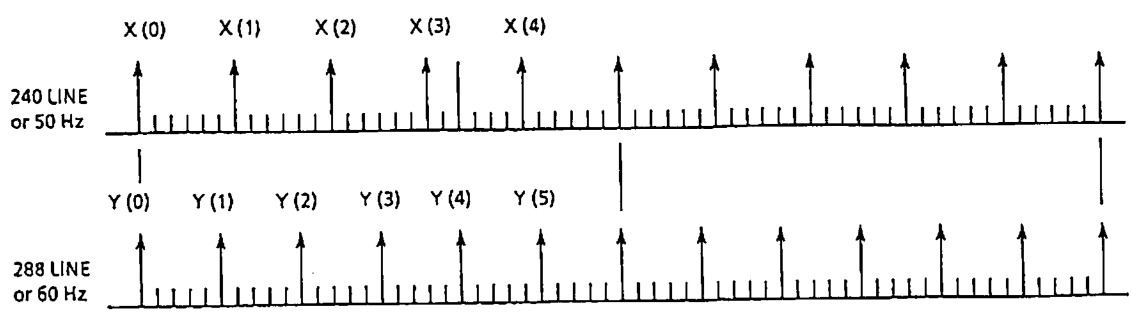
h(0) = -6.39260E-6	h(8) = 6.17046E-1
h(1) = 1.10641E-4	h(9) = -1.59975E-1
h(2) = -9.15304E-4	h(10) = 5.75909E-2
h(3) = 4.84772E-3	h(11) = -1.86983E-2
h(4) = -1.86983E-2	h(12) = 4.84772E-3
h(5) = 5.75909E-2	h(13) = -9.15304E-4
h(6) = -1.59975E-1	h(14) = 1.10641E-4
h(7) = 6.17046E-1	h(15) = -6.39260E-6



2. Filters #2 and #4: Line number conversion and line number inverse conversion

The line number conversion is the DD conversion whereby the number of pixels is increased from 5 to 6 and the line number inverse conversion is the DD conversion whereby the number of pixels is reduced from 6 to 5. It is noted that these filters of the line number conversion can be also applied to the field rate conversion (see document AVC-46 ANNEX-2).

The relationship between line phases is defined below.



The DD conversion is carried out by convolution as shown below.

5 → 6 pixels

$$Y(0) = \sum_{6} X(n) \quad A(6n)$$
$$Y(1) = \sum_{6} X(n+1) \quad A(6n+1)$$
$$Y(2) = \sum_{6} X(n+2) \quad A(6n+2)$$
$$Y(3) = \sum_{6} X(n+3) \quad A(6n+3)$$
$$Y(4) = \sum_{6} X(n+4) \quad A(6n+4)$$
$$Y(5) = \sum_{6} X(n+5) \quad A(6n+5)$$

6 → 5 pixels

$$X(0) = \sum_{5} Y(n) \quad B(5n)$$
$$X(1) = \sum_{5} Y(n+1) \quad B(5n-1)$$
$$X(2) = \sum_{5} Y(n+2) \quad B(5n-2)$$
$$X(3) = \sum_{5} Y(n+3) \quad B(5n-3)$$
$$X(4) = \sum_{5} Y(n+4) \quad B(5n-4)$$

Symbols A( ) and B( ) represent the filter impulse response specified in terms of the least common multiple of two sampling frequencies. The values of A( ) and B( ) are shown below.

5 → 6 pixels		
A (0)	=	0.1720003
A (± 1)	=	0.1638998
A (± 2)	=	0.1406403
A (± 3)	=	0.1041987
A (± 4)	=	0.0622558
A (± 5)	=	0.0224483
A (± 6)	=	−0.0085720
A (± 7)	=	−0.0279143
A (± 8)	=	−0.0349453
A (± 9)	=	−0.0306924
A (± 10)	=	−0.0190121
A (± 11)	=	−0.0047418
A (± 12)	=	0.0075985
A (± 13)	=	0.0153508
A (± 14)	=	0.0174394
A (± 15)	=	0.0141007
A (± 16)	=	0.0073454
A (± 17)	=	−0.0001909
A (± 18)	=	−0.0061524
A (± 19)	=	−0.0092482
A (± 20)	=	−0.0091445
A (± 21)	=	−0.0063005
A (± 22)	=	−0.0021072
A (± 23)	=	0.0018691
A (± 24)	=	0.0044591
A (± 25)	=	0.0051938
A (± 26)	=	0.0041948
A (± 27)	=	0.0020269

6 → 5 pixels		
B (0)	=	0.1726011
B (± 1)	=	0.1643169
B (± 2)	=	0.1406508
B (± 3)	=	0.1039267
B (± 4)	=	0.0616926
B (± 5)	=	0.0224288
B (± 6)	=	−0.0086314
B (± 7)	=	−0.0282429
B (± 8)	=	−0.0349480
B (± 9)	=	−0.0303331
B (± 10)	=	−0.0187759
B (± 11)	=	−0.0047539
B (± 12)	=	0.0077215
B (± 13)	=	0.0155316
B (± 14)	=	0.0172816
B (± 15)	=	0.0138882
B (± 16)	=	0.0072790
B (± 17)	=	−0.0001931
B (± 18)	=	−0.0062520
B (± 19)	=	−0.0092717
B (± 20)	=	−0.0090309
B (± 21)	=	−0.0062268
B (± 22)	=	−0.0021073
B (± 23)	=	0.0018911
B (± 24)	=	0.0044899
B (± 25)	=	0.0051893
B (± 26)	=	0.0041568
B (± 27)	=	0.0020216

(Normalized so that the equation $\Sigma A(n) = \Sigma B(n) = 1$ is obtained)