CCITT SGXV
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Experts Group for ATM Video Coding

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Subject: Merits of Square-Pel Aspect Ratio

Source: AT&T Bell Laboratories, Bellcore, DIS, NCS

Purpose: Discussion

1. Introduction

Certain fundamental issues which will affect the selection of a convenient picture coding format hierarchy include ease of spatial/temporal transcoding, pel aspect ratio and the type of scanning (i.e., interlaced vs. progressive). In this document we would like to emphasize that important consideration should be given to picture formats with square pel aspect-ratio. The SCIF proposal currently under discussion, i.e., 576 lines, 720 pels, is based on the CCIR Recommendation 601 which is mainly designed for entertainment television viewing and has a non-square pel aspect ratio.

It is becoming increasingly evident that the trend in telecommunications, computer and TV industries is for integrated work stations capable of supporting a variety of applications. These include the ability to display high resolution still frames containing text and graphics, medical imaging, videoconferencing and HDTV. In this document we examine the existing and future picture formats that are under consideration for applications in: videoconferencing, personal computers/computer worksations, digital TV/HDTV, cinematographic productions and high resolution printing. Our primary focus is to find out to what degree square-pels are being used across different industries? This in turn should provide us with the rational behind why square-pel needs to be chosen. Finally, examples of picture formats with square pel geometry will be presented as alternatives to the SCIF format currently under discussion, i.e., 576 lines, 720 pels.

2. Existing and Possible Future Picture Formats

In this section we provide several Tables indicating horizontal/vertical resolutions and the pixel geometry (e.g., whether the pixels are square or not).

System	Hor.	Ver.	Pel-Aspect Ratio
CGA	640	200	Non-Sq.
VGA	640	480	Sq.
PGC	640	480	Sq.
EGA	640	350	Non-Sq.
Hercules	720	350	Non-Sq.
8514 display adaptor	1024	768	Sq.
Computer Workstations	1280	1024	Sq.

Table 1: Personal Computer & Workstation Applications

System	Hor.	Ver.	Pel-Aspect Ratio
QCIF	180	144	Non-Sq.
CIF	360	288	Non-Sq.
SCIF	720	576	Non-Sq.
Square Pixel NTSC	640	480	Sq.
Square Pixel PAL	768	576	Sq.
4FSC NTSC	768	480	Non-Sq.

Table 2: Videoconferencing Applications

System	Hor.	Ver.	Pel-Aspect Ratio
CCIR Rec. 601 60 Hz	720	483	Non-Sq.
CCIR Rec. 601 50 Hz	720	576	Non-Sq.

Table 3: Digital TV Broadcast Applications

System	Hor.	Ver.	Pel-Aspect Ratio
Philips/Sarnoff/ATRC	1440	960	Non-Sq.
General Instrument	1408	960	Non-Sq.
MIT	1280	720	Sq.
Zenith/AT&T	1280	720	Sq.
NHK	1920?	1035	Non-Sq.
CIF format	1920	1080	Sq.
E. C. Square Pel	2048	1152	Sq.
E. C. #1	1920	1152	Non-Sq.
Computer/Film (U.S.)	2048	1152	Sq.
Computer/Film (E.C.)	2048	1152	Sq.

Table 4: HDTV Formats Under Consideration

System	Hor.	Pel-Aspect Ratio
Eastman Kodak	4096, 3656	Sq.
Pacific Title/DemoGraFX	4096, 2048	Sq.
Disney	4096, 2048	Sq.
Pacific Data Images	4096, 2048	Sq.
RFX	4096	Sq.
R Greenberg	4096, 2048	Sq.
Pixar	4096, 2740	Near-Sq.

Table 5: Digital Film Production Formats
(vertical resolutin is determined by aspect ratio)

System	Hor.	Ver.	Pel-Aspect Ratio
Cinema Postproduct	3840	2160	Sq.
Printed Page	3840	2880	Sq.
Kodak Photo-CD Base	768	512	Sq.
Kodak Photo-CD Display	1536	1024	Sq.
Kodak Photo-CD Print	3072	2048	Sq.

Table 6: Super HDTV Applications

3. Discussion

In considering the construction of a digital hierarchy of picture formats, square-pel aspect ratio should play a major role. In fact Tables 1, 4-6 show that both computer and film industries require square pels; and that similar trend can also be seen in the HDTV industry. In this section we would like to further elaborate on the merits of using square pels. These merits are:

1. With the anticipation of an open system environment, it is natural to expect exchange of imagery data. This, in concept, is similar to the current practice of exchanging portable softwares.
2. Related to the above is to minimize the amount of filtering due to its adverse effect in the loss of picture quality. Clearly, the conversion needed to go from non-square to square or another non-square pel aspect ratio is orthogonal to the above requirement.
3. For many computer and graphic-oriented applications a 90 degree rotation with no loss in perceived picture resolution is a must. Non-square pixels, in general, will lead to such a loss.
4. In applications such as medical imaging, landsat data and all forms of geological cartography it is necessary to preserve geometric fidelity of the data. Since these applications use square-pixels, any transformation to non-square pixels will lead to pel accuracy loss.
5. In computer industry, many types of fonts, both in outline and pixel form, have been designed for square-pel raster display and printers.
6. Most CCD sensors, LCD and active matrix flat-panel displays are designed with square-pel raster configuration.

4. Conclusion

In this document we have shown the technical merits of using square-pel geometry. Although, the square-pel concept seems to be quite attractive, work is still needed to provide specific raster configuration close to CCIR Rec. 601. One possible raster format namely 704X528 was suggested in Doc. AVC-60. A second alternative is to use a 768X576 raster. In addition to providing square-pel aspect ratio, this format has the following characteristics:

1. Number of pels/line (i.e., 768) matches with the horizontal resolution of 4FSC NTSC and square pixel PAL.
2. Square-pel 1024X576 raster becomes a convenient transform for 16:9 aspect ratio.