

VIDEO COMPRESSION DECK FOR A MODULAR FLIGHT PCM ENCODER SYSTEM

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ABSTRACT

Overview of video compression modules developed and flown as part of PSL's flight-proven family of modular PCM components. Wavelet based video compression deck is compatible with PCM Encoder modules, allowing video to be included in instrumentation data stream. Video compression modules allow the user to select video frame rate and video quality, supports 8-16 bits/word, and non-symmetrical PCM matrices. Video Compression and formatting is achieved with a wavelet compression IC and specialized DSP code. Video output is achieved with PSL PCM Decommulator and Video Decompression Module.

KEYWORDS

Video, Video Compression, modular PCM system.

INTRODUCTION

Adding a video compression interface to a modular PCM encoder eliminates the need to utilize separate data links for instrumentation and video. The video compression ratio can be varied by both frame decimation and compression ratio. The compressed video is packetized into a transport stream and serially sampled from the video compression module by the control module. The video data is correlated out of the PCM data stream, decompressed and output as NTSC video. This system has been flown successfully on a sounding rocket on December 19, 2000.

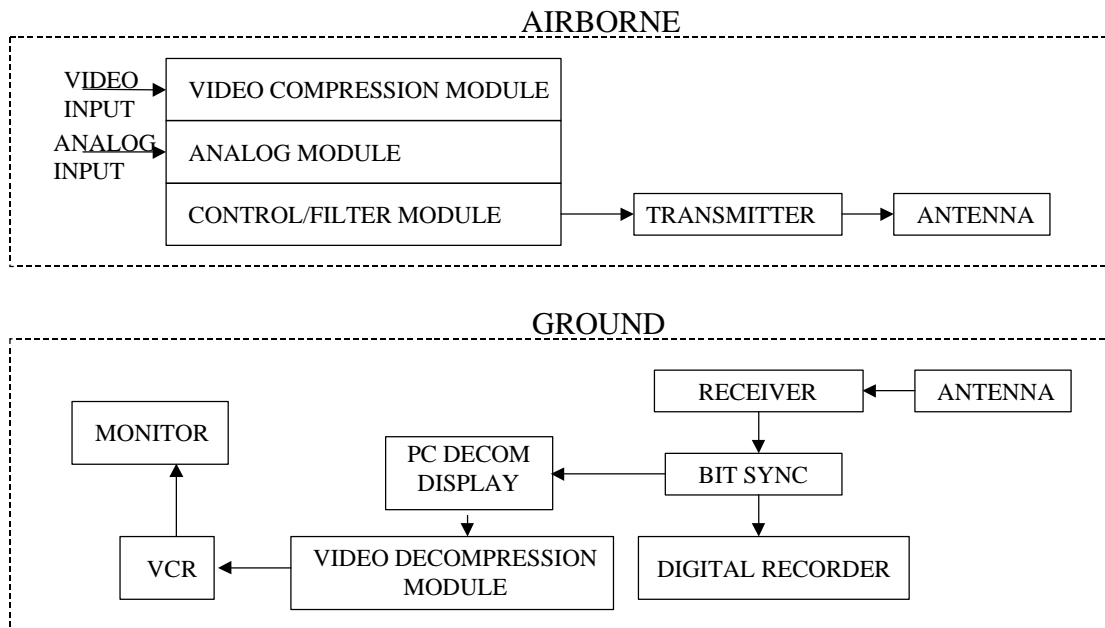
SYSTEM OVERVIEW

The Video compression system consists of an airborne (flight) system and ground system. The airborne system consists of video compression module mated into a PCM encoder system, which may include analog, parallel, RS-232/422, and other instrumentation modules. A control module, power module, and filter module must be included in the PCM stack. The filtered PCM output is then fed to a S-Band transmitter and antenna system. For the test flight the system consisted of: 3 Analog modules, 1 Parallel module, 1 Asynchronous Serial Module, 1 Time Event Module, 1

Power Module, 1 Control Module, 1 Filter Module, 1 Analog Video Module, and 1 Digital Video Compression Module. The ground system consists of receiving antenna, receivers, bit sync, PCI Decom, video decompression module, VCR, monitor, and digital recorder. All components for the ground system were COTS hardware with the exception of the PCI Decom and decompression module, which were developed specifically for the task. The PCI Decom is now available with the video output as a standard feature.

The system was flown with a 4 Mbps data rate; the video compression system consumed 2.064 Mbps of the total data rate utilizing a supercommutated non-symmetrical PCM matrix. The system achieved a 12 fps video rate. The video compression ratio achieved was approximately 104:1. The digital video bus is 8 bits wide and runs at 27 MHz.

Video Compression System Block Diagram



AIRBORNE HARDWARE DESCRIPTION

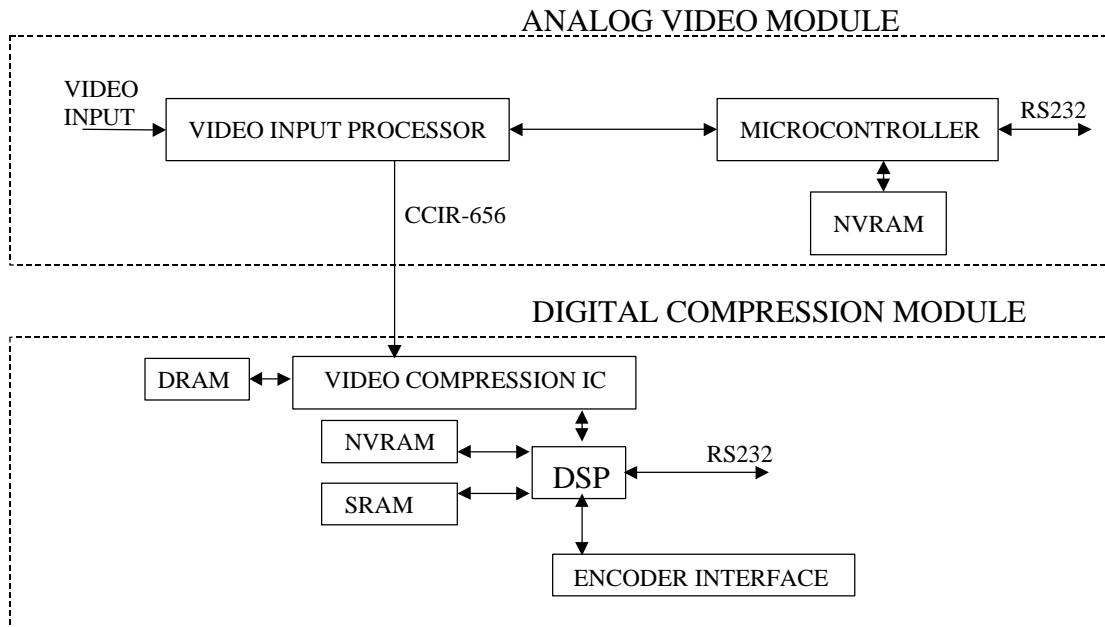
The modular video compression system was separated into two parts: the analog video digitization module and the digital video compression module. This was done to allow future upgrades to either system in the advent of new technology.

The analog video digitization module allows for one of four switchable CVBS or one of two Y/C video inputs to be digitized into an 8-bit CCIR-656 format. The video inputs can be switched via a TTL signal. On power-up a microcontroller reads a small NVRAM and sets the video input processor to preset values via an IIC bus. The microcontroller has an RS232 interface, which

allows the user to program all registers on the VIP (video input processor) in real-time via a Windows program. Once the user is satisfied with the VIP settings they can be saved in the NVRAM.

The Digital Video Compression (DVC) module compresses the 8-bit CCIR-656 data stream, creates a serial data stream and interfaces with the control deck to include the data in the PCM format. The DVC must be programmed with the target bit rate and video field desampling rate. The actual video compression ratio is controlled by a digital servo loop that maintains the memory buffer at a 50% fill ratio when read by the PCM control module. With this method the entire allocated PCM video bit rate is utilized. The serial bit stream created is a MPEG 2 program elementary stream with a 188 byte transport packetization.

Video Compression Module Block Diagram

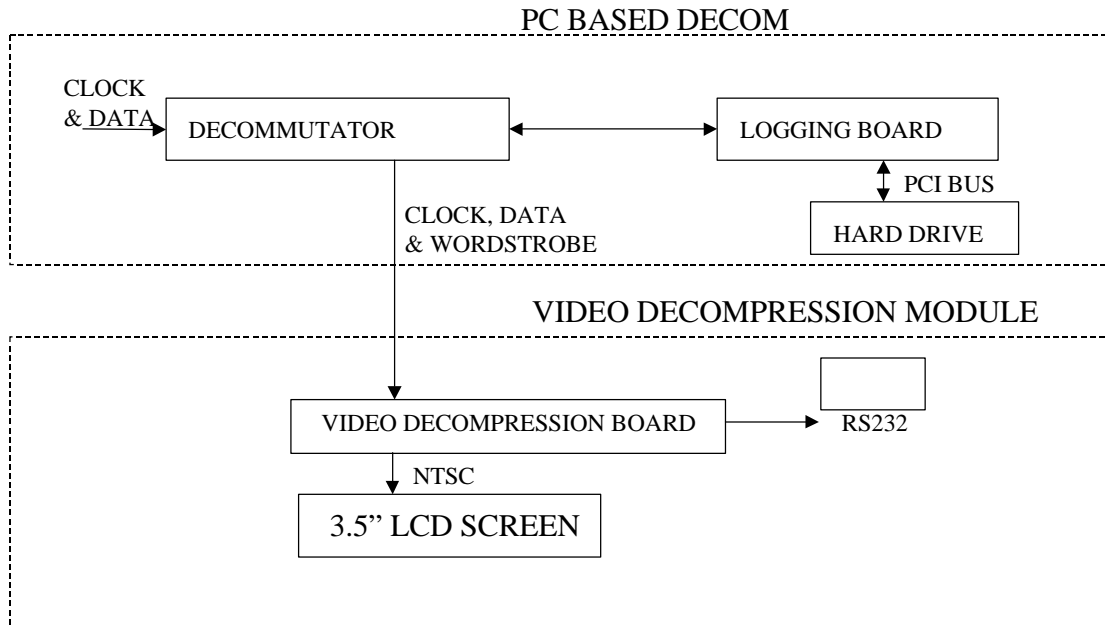


GROUND HARDWARE DESCRIPTION

The components developed for the ground system included a modified PCI decom and a decompression module. The PCI decom was modified to correlate the transport packet header and output a synchronous serial stream with a 16 bit word strobe. This allows for various bits per word configurations, with no additional overhead. For the test flight the system was flown with 10 bits/word. The decompression module has a small TFT screen to display the decompressed video, as well as, video output ports for recording and display. The PCI decom system also

contained a logging board, which allowed the entire PCM stream to be recorded on the hard drive. Post flight the video data was extracted from the PCM stream for further analysis.

Video Decompression Module Block Diagram



FUTURE UPGRADES

In the near future the video decompression module will be modified to allow the user to input video, then specify a bit rate and frame rate to determine the quality of compressed video. Additional upgrades in the future may include incorporating a single user interface for both the analog video module and the video compression module. For further video compression, frame differencing techniques may be explored.

CONCLUSION

The video compression modules can eliminate the need for an additional analog video link, by allowing compressed digital video to be included with instrumentation data. The video compression modules can be useful when encryption of video data or all measurement data is required. Typical bit rate requirements for the compressed video are 500 Kbps – 8 Mbps depending on quality and frame rate requirements. The video compression can work at lower bitrates, but the frame rate required to maintain acceptable quality suffers.

REFERENCES

1. Jack, Keith, "4:2:2 Digital Component Video", Video Demystified, 2nd Edition, HighText Publications, San Diego, CA1996, pp 356
2. Jack, Keith, "MPEG 2", Video Demystified, 2nd Edition, HighText Publications, San Diego, CA1996, pp 569
3. Recommendation ITU-R BT.601.5, "Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios", 1995
4. Recommendation ITU-R BT.656-4, "Interfaces for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level recommendation ITU-R BT.601", 1998