Design and construction of Video extractor

Mohamed Abdul-whab* ***Razi J. Al-Azawi****

Date of acceptance 12/6/2007

Abstract:

Design and construction of video extractor circuit require an understanding of several parameters, which include: Selector circuit, extracting circuit which contains sampling signal and multiplexing. At each radar pulse, the video signal is fed to one of the selector. The fast filter has a pass –band from 190 Hz to 1800 Hz. These frequencies correspond to targets having radial velocities laying between and 10 Kph and 200 Kph.Slow filter: 60 Hz to 230 Hz for radial velocities laying between 3.5 and 13 Kph.The video- extractor is organized in four PCB CG (A-B-C-D) each one having 16 selector. The sampling signal (ADS) (1-2-3-4) control the 4-line-to-16-line decoders. 8 multiplexers of 8 inputs each, are required for the multiplexing of the 64 selectors.

Introduction:

Moving targets may be distinguished from stationary targets by observing the video output on an A-scope (amplitude vs. range). A single sweep on an A-scope might appear as in Fig (1) (a). This sweep shows several fixed targets and two moving targets indicated by the two arrows. On the basis of a single sweep, moving targets cannot be distinguished from fixed targets. It may be possible to distinguish extended ground targets from point targets by the stretching of the echo pulse. However, this is not a reliable means of discriminating moving from fixed targets since some fixed targets can look like point targets. Also, some moving targets such as aircraft flying in formation can look like extended targets. Successive A –scope sweeps (pulse –repetition intervals)are shown in Fig (1) (b to e).Echoes from fixed targets remain constant throughout, but echoes from moving targets vary in amplitude from sweep to sweep at a rate corresponding to the Doppler frequency. The superposition of the successive A-scope sweeps is shown in Fig. (1) (f).

The moving targets produce, with time, a “butterfly “effect on the A-scope. A transversal filter with N outputs can be made to form a bank of N contiguous filter covering the frequency range from 0 to f_p, where f_p = pulse repetition frequency.[1]. A filter bank covering the Doppler frequency range is of advantage in some radar applications and offers another option in the design of MTI signal processors. Consider the transversal filter that was shown in fig. (2) to have N-1 delay lines each with a delay time $T=1/f_p$. Let the weights applied to the outputs of the N taps be:

$$w_{ik} = e^{-j[2\pi(i-1)k/N]} \quad \text{...... (1)}$$

where i=1,2,….*N* represents the i th tap , and k is an index from 0 to *N*-1 .Each value of k corresponds to a different set of *N* weights, and to different doppler-filter response .The *N* filter generated by the index k constitute the filter bank.

The impulse response of the transversal filter of the fig. (3) With the weights given by eq. (1) is

* Dr. University of Technology /Laser and optoelectronics Engineering Dep. Mohhamedwhab2006@yahoo.com
**Assistant Lecturer /University of Technology /Laser and optoelectronics Engineering Dep.

$$h_k(t) = \sum_{i=1}^{N} \delta[t-(i-1)T] e^{-j2\pi(i-1)k/N} \quad \text{.... (2)}$$

The Fourier transform of the impulse response is the frequency response function

$$H_k(f) = e^{j2\pi(i-1)[fT-k/N]} \quad \text{........ (3)}$$

The magnitude of the frequency response function is the amplitude passband characteristic of the filter .Therefore

$$|H_k(f)| = \left|\sum_{i=1}^{N} e^{j2\pi(i-1)[fT-k/N]}\right| = \left|\frac{\sin[\pi N(fT-k/N)]}{\sin[\pi(fT-k/N)]}\right| \ldots (4)$$

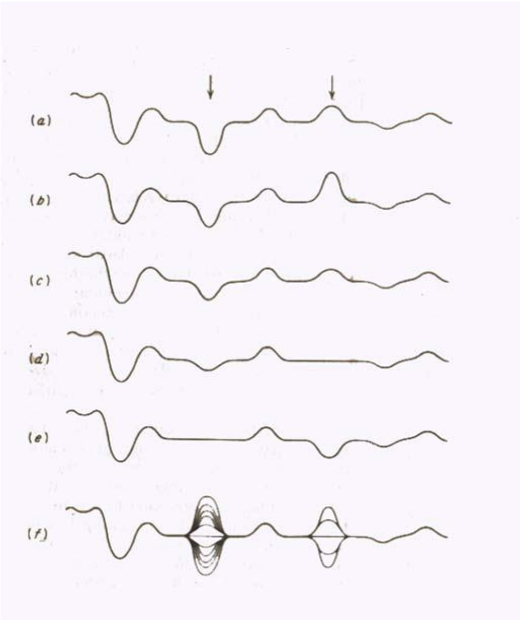

Fig. (1) A singl sweep on an A-scope

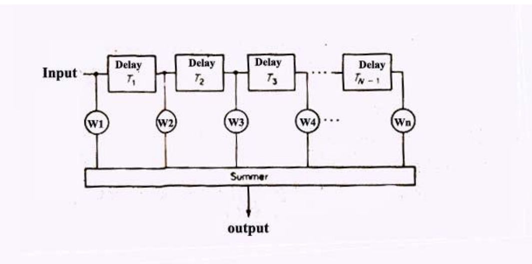

Fig. (2) delay lines each with a delay time $T=1/f_p$

Experimental work and results

The video- frequency signal is analyzed in the extractor by the 64 gates evenly spaced over the range scale.

In the normal mode: over 20,480 m in 320 m interval.

In the expand mode: over 2,560 m in 40 m interval.

In the latter mode, the analysis origin can be moved in 2000 m steps between 0 and 18,000 m or between 10,000 and 28,000 m such that the whole of the useful range can be analyzed in 20 steps with a 560 m overlap .the analysis gates are in the form of modules, known as selectors. They are divided into 4 groups of 16 modules Z1 to Z16, on 4 identical printed circuit boards as shown in Fig (3) (a) Block diagram (b) Circuit diagram . In order to avoid interaction between two neighboring samplers, the video inputs of the gates are wired in two groups, one for the even – numbered gates, and the other for the odd – numbered gates. The first group is fed with the video –frequency signal VDPA, whilst the second is fed with signal VDIP as shown in Fig (3) (b).[2].

The 64 gates triggering binary states are also organized in 4 groups of 16 pulses by means of four 16- bit decoders (MN1 of CG) triggered by the addressing clock signals ADS and enabled by signals CDS as shown in timing diagrams Fig (4) and Fig (5) . The sampling signal ADS (1-2-4-8) control the 4-line to-16-line decoders (MN1), through the AND gate MN4 as shown in fig (3) (b). Each selector output is connected to a multiplexing circuit, in order to multiplex the 64 selectors outputs in serial message ECOS.[3]. The multiplexers of 8 inputs each, are required for the multiplexing of the 64 selectors (MN2-MN3) as shown in Fig (3)(b) . The ENABLE signal is the CMS (1 to 8): as shown in timing diagram in Fig (6). The addresses inputs are defined by: A0 = 3660 H

A1 = 1830 H

A2 = 915 H

They allow to count from 0 to 7, either addresses in respect with the synchronization 3660 Hz.

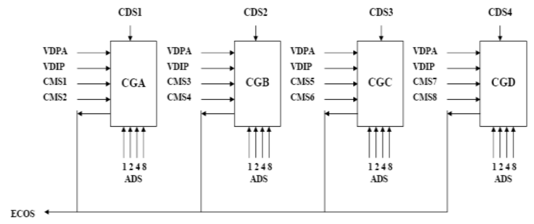

Fig. (3) (a) Block diagram of 4 groups of 16 modules Z1 to Z16

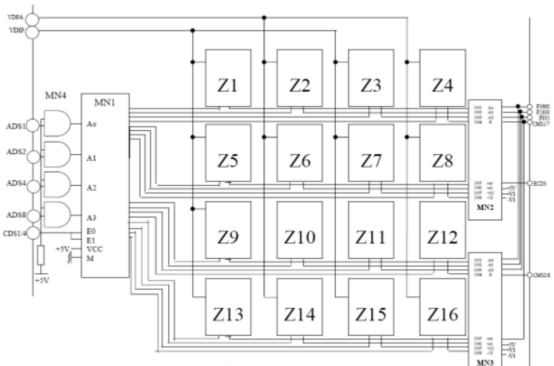

Fig. (3) (b) Circuit diagram

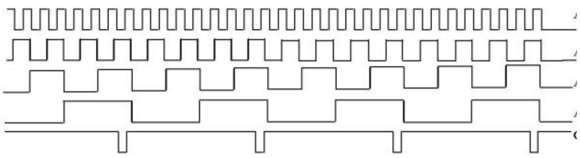

Fig. (4) Timing diagram of ADS

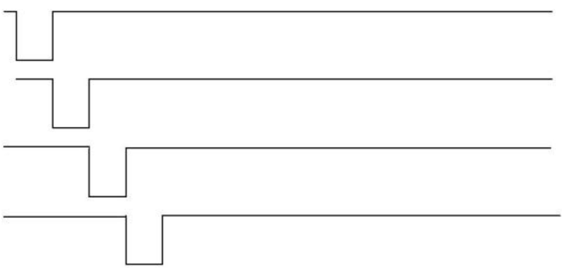

Fig. (5) Timing diagram of CDS

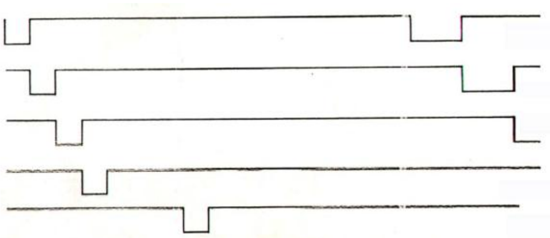

Fig. (6) Timing diagram of CMS

Conclusions:

There are many elements affecting the video extracting circuit and these elements are very necessary to consider, they are:

First: the sampled signal feeds two pass-band filters who only (1) is working,

- A- Fast filter if fast target is selected.
- B- Slow filter if slow target is selected.
- C- Fast filter if fixed target is selected.

Second: at the output of the filter a signal is obtained and feeds a gain amplifier which the level can be adjusted by means of an external potentiometer.

Third: each selector output is connected to multiplexing circuit, in order to multiplex the 64 selectors outputs in a serial message ECOS.

Fourth: Digital signal processing has some significant advantage over analog delay lines. As with most digital technology, it is possible to achieve greater stability, repeatability and precision with digital processing than with analog delay –line cancellers.

Reference:

1. Jacob Millman, 1972, "Integrated Electronics: Analog and digital circuits and system", McGraw-Hill Kogokusho, Ltd, Inc.

2. "Signal Prossing Toolbox for use with MATLAB" Math words, Inc.1999.

3. Esbensen, H. & Kuh. E. 1996, "Synthesis of CMOS Operational Amplifiers through Genetic Algorithm", Proc. Of European Design Automation Conference, pp:356-361.

تصميم وبناء مستخرج فيديوي

محمد عبد الوهاب منشد ***رازي جبر العزاوي****

*مدرس/ الجامعة التكنولوجية/ قسم هندسة الليزر والبصريات الالكترونية
**مدرس مساعد/ الجامعة التكنولوجية/ قسم هندسة الليزر والبصريات الالكترونية

الخلاصة:

ان تصميم وبناء مستخرج فيديوي يتطلب دراسة عدة عوامل والتي تتضمن: دائرة المنتخب، دائرة المستخرج والتي تحتوي على دائرة اشارة الاختبار ودائرة الارسال المتعدد المتقابل.

ان اشارة الفيديوية تغذي واحدة منة دوائر المنتخب عند كل نبضة رادار. المرشح السريع(Pass-band)من(190-1800)هرتز ان هذه الترددات تناظر اهداف تملك سرع نصف قطرية تقع ما بين 10 كم/ ساعة و200 كم/ ساعة.

المرشح البطيء 60 هرتز الى 230هرتز لسرع نصف قطرية تقع ما بين 3.5 كم/ساعة الى 13 كم /ساعة. ان المستخرج الفيديوي نظم بأربعة دوائر الكترونية ((CG(A-B-C-D) كل واحد يحتوي على 16 منتخب. ان اشارة الاختبار ((ADS(1-2-3-4) تسيطر على (decoders) (4- line-to-16-line).