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Cognitive Amplifier: A New Approach for Cable Television

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***Abstract*: Intelligent, Cognitive and Conscious Machines are considered as the future of design in system engineering. These are used in every field of engineering. In this concept paper, a new idea of cognitive amplifier is introduced. Its application in cable television is discussed. The steps of cognitive cycle are discussed. The pictorial diagram of traditional amplifier and cognitive amplifier with its responses is shown to explain the concept. The gain control capability of cognitive amplifier for signal transmission system is shown pictorially. This concept provides flat response for the good quality picture and sound response at all channels.**

***Index Terms*: Amplifier, Cognitive amplifier,**

I. INTRODUCTION

Many researchers are working on intelligentization and computerization of traditional systems capable of sensing, learning, deciding and acting by using Artificial Intelligence (AI) methods onto embedded systems. Embedded system found applications in almost all the fast developing sectors like home appliances, automobile, aeronautics, space, rail, and mobile communications etc. with the availability of the software in design of embedded systems. Embedded system that is able to intelligently adapt itself to the changing environment is called cognitive embedded system [1].

In 2000, Joe Mitolla introduced the concept of a cognitive radio towards wireless services and related computer to computer communications [2].The cognitive radio and cognitive networks are able to provide variety of intelligent and smart behaviors to the networks, applications and devices.

Amplifiers are the basic building blocks in electronics communications systems, used for increasing the power of a signal. Numerous types of amplifiers are available to various applications in communication engineering [3]. In cable television, amplifier is a box that boosts television signals over cable television frequency bands of various channels to give clear reception at television sets. In cable television co-axial cables are running from distribution box at one place to the customer's house. The cable television frequency signals, when travel over a long cable run (> 150 feet), the higher channel (high-band) signals tend to lose the strength faster than lower channel(standard-bands) signals [4]. The hardware based path equalizing (Tilt) amplifiers are used to compensate for non uniform coaxial cable characteristic for television bands of various channels. Cable guys works lot to maintain the quality of television reception at home. This create the need for a new class of cable television amplifier which sense, learn , decide and act and can be termed as cognitive amplifier.

In order to design the cognitive amplifier has some steps, which are enumerated as and pictorially shown in figure 1 [5]:-

(a) Frequency spectrum sensing
(b) Learning
(c) Decide action
(d) Act

The first step is to sense the frequency spectrum that is used for channels transmission. Spectrum sensing is important task of cognitive radio [5]. The same can be used for cognitive amplifier. The learning and deciding depend upon inference rules that may be designed to decide the different gain at different frequency band at different period of time, and act accordingly at the receiver.

The presented paper mainly emphasis on sensing the cable television frequency /spectrum signal through coaxial cable and amplifying the television channels as per its need. A general idea about traditional amplifier with its frequency response, coax cable frequency response, and the output of the amplifier is given in section II. The section III discusses about the concept of cognitive amplifier. Whereas the gain control capability of cognitive amplifier is discussed in section IV. Finally conclude with future directives in section V.

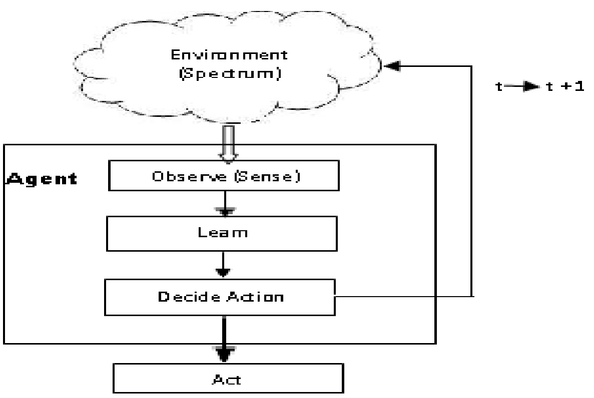

Fig 1: Simplified Cognition Cycle for Amplifier

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I. RELATED WORK

In the present paper two concepts are mixed and a novel concept of cognitive amplifier is introduced. The cognitive radio concept developed by Joe Mitolla in 2000 [2] and further modified and implemented by number of researchers [6]-[27]. This concept is further used for designing of cognitive robotics [28]- [35] .Now a days traditional amplifier is designed by using circuits of active elements [36]. Dongjiang Qiao et al presented an intelligent amplifier using microelectro-mechanical system (MEMS) [37].Advancement in software and embedded systems design using microprocessors, FPGA and DSP processors have enabled to design the new class of amplifier that may be called as cognitive amplifier.

Traditional amplifiers have constant gain across the range of frequencies called as bandwidth of the amplifier. The pictorial representation of symbol of an amplifier, Frequency response curve of an amplifier, Frequency response curve of a coaxial cable and the output of traditional amplifier used for coaxial cable are shown in figure 2. Cable TV system used coaxial cable for transmission the television programmes among the user [38]. The coaxial cables frequency response is not uniform across the television frequency bands amplifiers [39]-[41].

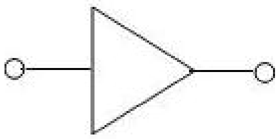

Fig 2a: Traditional amplifier

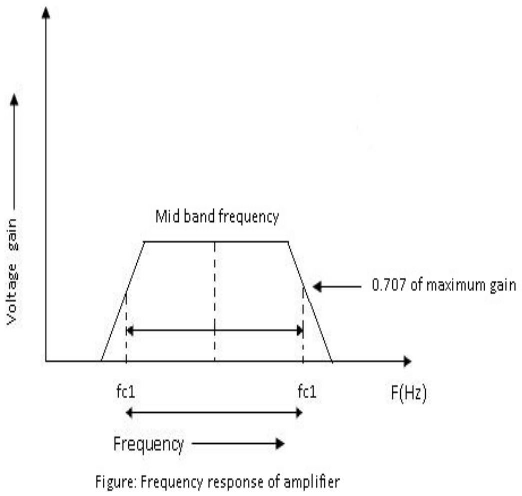

Fig2b: Frequency response curve of an amplifier

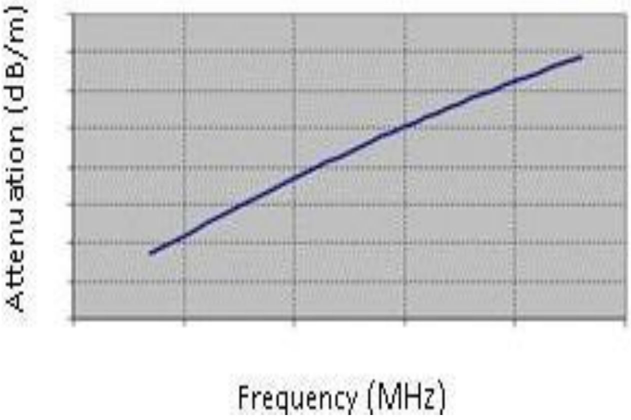

Fig2c: Frequency response of coaxial- cable

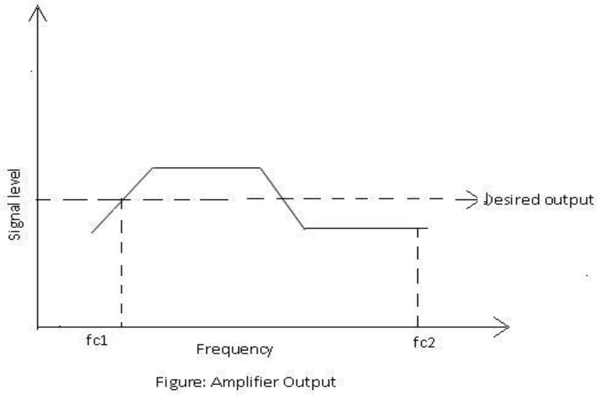

Fig 2d: output of traditional amplifier used for coaxial cable

The traditional amplifier amplifies all the TV channels uniformly over the frequency range of coaxial cable. Other side the channels are attenuated non-uniformly in the coaxial cable used in cable TV. Due to which the amplifier output of high frequency band channels are affected and their picture quality is poor.

This creates the need for the amplifier that is aware of attenuation of the signals at the range of frequencies and amplifies accordingly.

II. NEW CONCEPT

Mixing the concept of cognitive cycle with/in a cable television amplifier used with coaxial cable gives the new class of amplifier that may be called cognitive amplifier. This concept is discussed in figure 3.

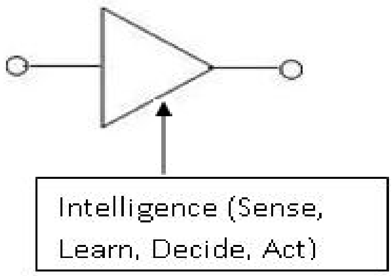

Fig3a: Symbol of Cognitive amplifier

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In figure 3a the symbol for cognitive amplifier is purposed. This shows that the amplifier intelligently amplify the spectrum band for transmission of television signal (more than 100 channels). It use the concept of cognitive cycle i.e. sense, learn, decide and act according to the attenuation of the signal in the cable.

There is degradation in the amplitude of transmitted signal due to different reasons. Let consider the coaxial cable. It is the cheapest one for CATV transmission to homes from the main node. But in co-axial cable the losses are increased as the frequency increased shown as shown in figure 3c. Therefore in contrast to voltage gain of traditional amplifier, voltage gain of cognitive amplifier (purposed class of amplifier) is non uniform over the television channels as shown in figure 3c. Figure 3d, shows the desired response of cognitive amplifier.

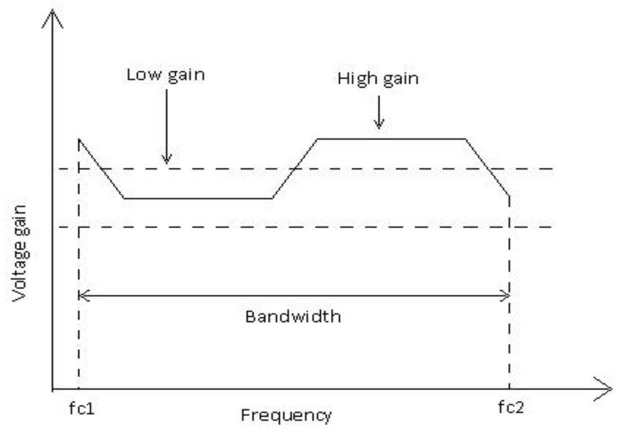

Fig3b: frequency response of cognitive amplifier (non uniform)

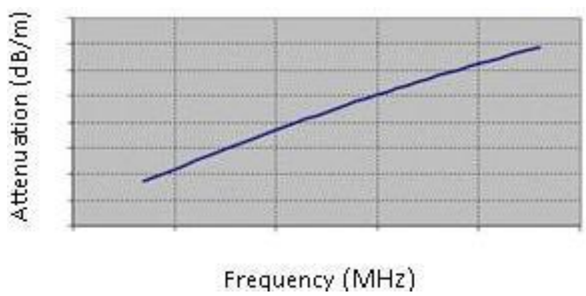

Fig3c: Frequency response of coaxial- cable

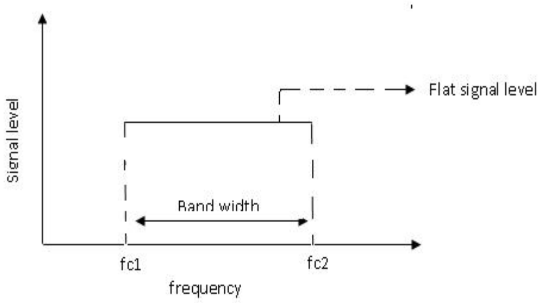

Fig3d: Cognitive amplifier output

III. EFFICIENT EVALUATION OF GAIN CONTROL CAPABILITY

This introduces the gain control capability in CATV amplifiers and compensates for loss caused by cables. In general gain control capability is evaluated by measuring and comparing the cable loss and the amplifier gain. To ensure efficient evaluation, it is possible to assume a transmission system composed of cable and amplifier as shown in figure 4, and to evaluate the gain achieved by the combined effect of cable and amplifier together. Transmission system gain is given by equation as follows:

Equation---

Transmission system gain [db] =CATV amplifier gain [db] – cable loss [db]

That is where the system provides proper flatness over the entire frequency band determines the gain control performance of CATV amplifiers. With this method, frequency characteristic loss is required to sense.

We always need a flat response for the good quality picture and sound response at all channels. So we need amplifier /booster to adjust gain for the desired response.

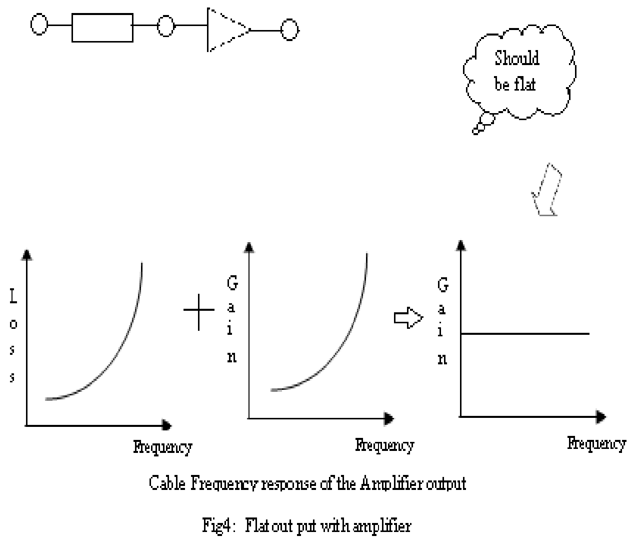

Fig4: Flat out put with amplifier

V. CONCLUSION

This paper emphasizes on new approach for the design of amplifier for cable television. This class of amplifier may be called cognitive amplifier. It may be used in other application also.

This approach provides intelligent amplification that sense, learn, decide and then amplify accordingly. The proposed concept will provide a new approach to the arena of amplifier design. Further this concept may be use for the design and implementation cognitive amplifier.

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Naveen Kumar Malik is working as an Assistant Professor in the Department of Electronics and Communication Engineering at Hindu College of Engineering, Sonepat, Haryana. He is having total of around twelve year experience in teaching field. Malik N.K. obtained his B.Tech. in Electronics and Communication Engineering from Institute of Technology and Management ,Sector-23,Gurgaon,Haryana and M.Tech in Electronics and communication Engineering from Department of Electronics and Communication Engineering, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Sonepat, Haryana. He is pursuing his Pre-PhD in Electronics and Communication Engineering at U.I.E.T., M. D. University ,Rohtak, Haryana. His current research includes intelligent and cognitive machines. He has published several research papers in international journals/ Conferences.

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