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**(54) Title**: SIGNAL ACQUISITION USING A MULTI-FREQUENCY CHOPPING IN A SINGLE CIRCUITRY

**(57) Abstract**: The present invention discloses a method and system for processing a plurality of signals together in a single circuitry using a multi-frequency chopping. The system is configured to include a first level chopping, an amplifier for amplification, a second level chopping, a filter for filtration and an Analog to Digital Converter (ADC). The system is further configured to receive low frequency input signals and apply the first level of chopping by translating signals to a higher frequency. Further, the system is configured to amplify the signals and apply the second level of chopping to translate the signal back to original frequency. During second level of chopping, signals are translated to new frequencies other than their baseband by chopping each signal at a different frequency. Further, the signals are combined into a single signal and send to an Analog-to-Digital Converter (ADC) for digitizing.

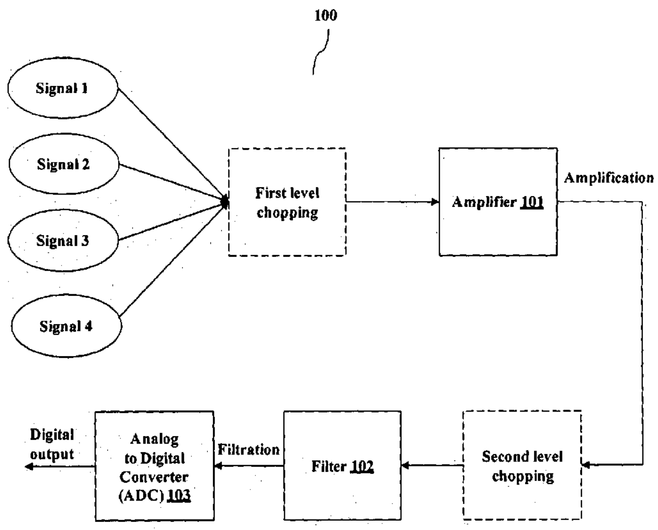


FIG. 1

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# SIGNAL ACQUISITION USING A MULTI-FREQUENCY CHOPPING IN A SINGLE CIRCUITRY

## FIELD OF INVENTION

[001] The embodiments herein relate to signal acquisition and, more particularly, to process different signals received from different channels together in a single circuitry using multi-frequency chopping.

## BACKGROUND

[002] Signal acquisition system measures real world physical conditions and convert an acquired analog signal into a digital signal for processing. A typical signal acquisition system includes a sensor to acquire the analog signal and convert the analog signal to the digital signal using an Analog-to-Digital Converter (ADC). When measuring low frequency analog signals using the signal acquisition system, the analog signals have unfavorable noise characteristics at low frequency and it is necessary to process the analog signals in a high frequency.

[003] For example, consider biopotential signals generated due to the electrochemical activity of certain cells present in different organs (like nervous, muscular or glandular tissues) of a body a human or non-human object. These signals have very low amplitude and their frequency content is quite low (few hundreds of mHz to few hundreds of Hz). Generally, a multi-

channel biopotential signal acquisition system having several electrodes is used to detect and acquire the biopotential signals from the human or non-human object. Each biopotential channel include an electrode for acquiring a biopotential signal, an amplifier for amplifying the acquired biopotential signal and a filter for filtering out undesired amplified signals to provide a biopotential output signal. As the frequency of these types of signals is very low, the effect of noise is very high and greater difficulties in its measurement and assessment. Moreover the effects of DC offset are also high at these frequencies.

[004] Currently, chopper stabilization is a technique to combat noise and the DC offset of the amplifier constituting the analog front end of the signal acquisition system. In the chopper stabilization, low frequency signals are chopped to translate to higher frequencies where noise is much lower and effects of DC offsets are absent. Further, at these frequencies, high gains are available for the translated signals. Once desired amount of gain is achieved, the resulting signals are chopped again to translate it back to its original frequency. Thus, each signal is processed individually by using separate circuitry for chopping and acquisition.

[005] As a result, over all power consumption, component count (Integrated Chip area) of the signal acquisition system increases which in turn

increases the complexity of the system. Thus, there is a need to simplify the analog front end of the signal acquisition system in order to reduce the overall power consumption and component count in the system.

## OBJECT OF INVENTION

[006] The principal object of the embodiments herein is to provide a method and system to process a plurality of signals together in a single circuitry using a multi-frequency chopping.

[007] Another object of the invention is to provide a method and system to process a plurality of biopotential signals in a single circuitry using a multi-frequency chopping.

## SUMMARY

[008] In view of the foregoing, an embodiment herein provides a method to process a plurality of signals together in a single circuitry using a multi-frequency chopping, wherein the method comprises receiving said plurality of signals from a plurality of channels. Further, the method comprises applying a second level of chopping to the received plurality of signals in at least one second frequency other than a first frequency, wherein the second level of chopping is applied after a first level of chopping using the first frequency, wherein applying the first level of chopping and the second level of chopping processes the plurality of signals together in the single circuitry.

[009] Embodiments further disclose a system for processing a plurality of signals together in a single circuitry using a multi-frequency chopping, wherein the system comprises at least one chopper amplifier, a filter, an Analog to Digital Converter (ADC). The system is configured to receive said plurality of signals from a plurality of channels. The system is further configured to apply a second level of chopping to the received plurality of signals in at least one second frequency other than a first frequency, wherein the second level of chopping is applied after a first level of chopping using the first frequency, wherein applying the first level of chopping and the second level of chopping processes the plurality of signals together in the single circuitry.

[0010] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings.

## BRIEF DESCRIPTION OF THE FIGURES

[0011] The embodiments herein will be better understood from the following detailed description with reference to the drawings, in which:

[0012] FIG. 1 illustrates an overview of a signal acquisition system using a multi-frequency chopping, as disclosed in the embodiments herein;

[0013] FIG. 2 is a flow diagram illustrating a method for processing different signals together in a single circuitry using a multi-frequency chopping technique, as disclosed in the embodiments herein;

[0014] FIG. 3 illustrates an example configuration of the signal acquisition system using the multi-frequency chopping, as disclosed in the embodiments herein;

[0015] FIG. 4 is a flow diagram illustrating a method for processing different signals together in a single circuitry using multi-frequency chopping using the example configuration of the FIG. 3, as disclosed in the embodiments herein;

[0016] FIGS. 5a-5o depict example graphs using the example configuration of the FIG. 3, as disclosed in the embodiments herein;

[0017] FIG. 6 illustrates another example configuration of the signal acquisition system using the multi-frequency chopping, as disclosed in the embodiments herein;

[0018] FIG. 7 is a flow diagram illustrating a method for processing different signals together in a single circuitry using multi-frequency chopping using the example configuration of the FIG. 6, as disclosed in the embodiments herein;

[0019] FIGS. 8a-8j depict example graphs using the example configuration of the FIG. 6, as disclosed in the embodiments herein; and

[0020] FIGS. 9a-9g depicts example simulation graphs using the example configuration of the FIG. 3, as disclosed in the embodiments herein.

## DETAILED DESCRIPTION OF EMBODIMENTS

[0021] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. Also, the various embodiments described herein are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments. The term “or” as used herein, refers to a non-exclusive or, unless otherwise indicated. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein can be practiced and to further enable those skilled in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0022] Prior to describing the present invention in detail, it is useful to provide definitions for key terms and concepts used herein. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by a personal having ordinary skill in the art to which this invention belongs.

[0023] First signal: Refers to any input signal having very low amplitude (μV-mV) and low frequency content (few hundreds of mHz to few hundreds of Hz). For example, a biopotential signal.

[0024] Second signal: Refers to any input signal having very low amplitude (μV-mV) and low frequency content (few hundreds of mHz to few hundreds of Hz). For example: a biopotential signal.

[0025] First frequency: Refers to any higher frequency where noise is much lower and effects of DC offset are absent on the input signal. In an embodiment, at this frequency, high gain can be attained for the given signal.

[0026] Second frequency: Refers to any higher frequency, which is other than the first frequency, where the noise is much lower and the effects of Direct Current (DC) offset are absent on the input signal. In an embodiment, at this frequency, high gain can be attained for the given signal.

[0027] First level of chopping: Refers to translating a desired low frequency signal into a higher frequency by modulating the low frequency signal with a higher frequency carrier signal.

[0028] Second level of chopping: Refers to translating a high frequency signal back to its original frequency (i.e., to its baseband) by demodulating the modulated signal with a different frequency other than the frequency used in the first level of chopping.

[0029] Multi-frequency chopping: Refers to chopping an input signal with different frequencies in the first level of chopping and in the second level of chopping such that the input signal is translated not to a baseband but to a new frequency.

[0030] The embodiments herein disclose a system and method for processing signals together in a single circuitry using multi-frequency chopping. In an embodiment, the system can be configured to include a first level chopping, an amplifier for amplification, a second level chopping, a filter for filtering chopped signal and an Analog-to-Digital Converter (ADC). The signal acquisition system is further configured to receive low frequency input signals (for example: a first signal and a second signal) and process them together in a single circuitry using multi-frequency chopping.

[0031] In an embodiment, during first level chopping, the signal acquisition system can be configured to translate the plurality of input signals (for example: the first signal and the second signal) to higher frequencies by modulating the first signal and second signal with a higher frequency (for example: a first frequency). Further, the signal acquisition system can be configured to amplify the chopped first signal and chopped second signal to achieve suitable gains. In an embodiment, the amplification of the chopped input signals can be done by passing the signals through the amplifier. Once the desired amount of gain is achieved at the higher frequency, the signal acquisition system can be configured to translate the amplified first signal and second signal back to original frequency by applying second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system can be configured to translate the first signal back its original frequency by demodulating the first signal with the first frequency. Further, the signal acquisition system can be configured to translate the second signal to a different frequency by demodulating the second signal with different frequency compared to the first frequency (for example: a second frequency).

[0032] After applying the second level of chopping, the signal acquisition system can be further configured to combine the two chopped signals and creates a single signal. Further, the filter can be configured to filter the noise in the single signal. In an embodiment, the filtration removes noise and harmonics that are added to the input signal during the first level of chopping and the second level of chopping. Further, the signal acquisition system can be configured to send the filtered signal to the ADC in order to digitize the signal.

[0033] In an embodiment, during first level of chopping, the signal acquisition system can be configured to translate the first signal and the second signal to different higher frequencies by modulating the first signal and the second signal with the first frequency and the second frequency respectively. The signal acquisition system can be further configured to combine the two chopped signals and creates a single signal. Further, the signal acquisition system can be configured to amplify the combined signal by passing through the amplifier.

[0034] The signal acquisition system can be further configured to translate the amplified signal back to lower frequency by applying second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system can be configured to translate the combined signal to lower frequency by demodulating the signal either with the first frequency or the second frequency.

[0035] As the above signal acquisition system combines different input signals into a single signal, while processing the signals, a single circuitry can be used. Hence, this reduces over all power consumption, component count (and IC area, if) of the system. In other words, the system complexity can be reduced since the single circuitry is used for processing different input signals.

[0036] For example, while processing biopotential signals, each individual channel present in biopotential signal acquisition system deliver multiple copies of a single signal to offer redundancy and to rule out channel abnormalities. Hence, for processing each biopotential signal in analog domain, separate circuitry must be used which increases overall power consumption and system complexity. By using the signal acquisition system using multi-frequency chopping, all input signals can be combined into a single signal and the single circuitry can be used to process all the input signals.

[0037] Referring now to the drawings, and more particularly to FIGS. 1 through 8, where similar reference characters denote corresponding features consistently throughout the figures, there are shown embodiments.

[0038] FIG. 1 illustrates an overview of a signal acquisition system using a multi-frequency chopping, as disclosed in the embodiments herein. In an embodiment, the signal acquisition system 100 can be configured to include a first level chopping, an amplifier 101 for amplification, a second level chopping, a filter 102 for filtration and an Analog to Digital Converter (ADC) 103. The signal acquisition system 100 can be further configured to acquire different input signals (for example: signal 1, signal 2, signal 3, and signal 4) and process them together in a single circuitry using a multi-frequency chopping.

[0039] During first level chopping, the signal acquisition system 100 can be configured to translate the input signals i.e., signal 1, signal 2, signal 3 and signal 4 to higher frequencies by modulating the signals with a first frequency. The signal acquisition system 100 can be further configured to amplify the chopped input signals i.e., signal 1, signal 2, signal 3 and signal 4 to achieve suitable gains. In an embodiment, the amplification of the chopped input signals can be performed by passing the chopped signals through the amplifier 101. Once the desired amount of gain is achieved at the higher frequency, the signal acquisition system 100 can be configured to translate the amplified input signals back to their original frequency by applying second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system 100 can be configured to translate signal 1 back its original frequency by demodulating signal 1 with the first frequency. Further, the signal acquisition system 100 can be configured to translate the other signals (signal 2, signal 3 and signal 4) to different lower frequencies by demodulating each signal with a second frequency, a third frequency and a fourth frequency.

[0040] After the second level of chopping, the signal acquisition system 100 can be configured to combine the four chopped signals and creates a single signal. The filter 102 in the signal acquisition system 100 can be configured to filter the single signal. In an embodiment, the filter 102 can be configured to remove noise and harmonics that are added to the input signal during the first level of chopping and the second level of chopping. The signal acquisition system 100 can be further configured to send the filtered signal to the ADC 103 which digitizes the single signal.

[0041] During first level of chopping, the signal acquisition system 100 can be configured to translate the input signals to different higher frequencies by modulating each input signal i.e., signal 1, signal 2, signal 3, and signal 4 with the first frequency, the second frequency, the third frequency and the fourth frequency respectively. The signal acquisition system 100 can be further configured to combine the chopped signals and creates a single signal. Further, the chopping amplifier 101 can be configured to amplify the single signal.

[0042] Further, the signal acquisition system 100 can be configured to translate the amplified signal to a lower frequency by applying second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system 100 can be configured to translate the signal back by demodulating the combined signal with any one of the first frequency or the second frequency or the third frequency or the fourth frequency. For example, the signal 1 is obtained from an Electrocardiography (ECG) electrode, the signal 2 is obtained from an Electroencephalography (EEG) electrode, the signal 3 is obtained from an Electromyography (EMG) electrode and the signal 4 is obtained from an Electrooculography (EOG) electrode.

[0043] Although the FIG. 1 is described with four input signals, it is to be understood that the there can be any number of input signals which can be processed together in the single circuitry using multi-frequency chopping technique as described herein.

[0044] FIG. 2 is a flow diagram which illustrating a method 200 for processing different signals together in a single circuitry using the multi-frequency chopping technique, as disclosed in the embodiments herein. In an embodiment, at step 202, the method 200 includes receiving a plurality of input signals from signal sources. For example, the method 200 allows the plurality of sensors to receive plurality of signals. The signal acquisition system 100 receives the input signals and processes them together in a single circuitry using a multi-frequency chopping. At step 204, the method 200 includes applying a first level of chopping to the plurality of input signals using a first frequency. The signal acquisition system 100 translates the plurality of input signals to higher frequencies by chopping (modulating) the signals with a higher frequency (first frequency). At step 206, the method 200 includes applying the second level of chopping for the chopped input signals using a second frequency. During the second level of chopping, the method 200 allows the signal acquisition system 100 to translate the signals to different frequency by demodulating the signals with frequencies other than frequencies used for first level of chopping (a second frequency). As a result, all the input signals are translated to different frequencies and the method 200 further allows the signal acquisition system to combine different signals to create a single signal. The various acts, steps, operations, and actions in the method 200 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some of the acts, steps, operations, and actions may be omitted or modified without departing from the scope of the invention.

[0045] FIG. 3 illustrates an example configuration of the signal acquisition system using the multi-frequency chopping, as disclosed in the embodiments herein. In this configuration, the signal acquisition system 100 is configured to include a first level chopping, an amplifier 101a, an amplifier 101b, a second level chopping, a filter 102, and an ADC 103,. In an embodiment, the signal acquisition system 100 is configured to receive two input signals i.e., signal 1 (first signal) and signal 2 (second signal) and process the two signals in a single circuitry by using multi-frequency chopping. For example, the single 1 is an ECG signal and signal 2 is an EMG signal. The signal acquisition system 100 is further configured to apply the first level of chopping to translate the first signal and the second signal to higher frequencies. In an embodiment, the first level of chopping can be applied by modulating the signals with a single higher frequency (f1). As a result, the first signal and the second signal are shifted to the higher frequency (f1) where the noise is low and the effects of DC offset are absent. In an embodiment, the filter 102 is configured to filter the noise from the first and the second signals after the first level of chopping. In an embodiment, the amplifier 101a is configured to amplify the chopped first signal to suitable a gain. In an embodiment, the amplifier 101b is configured to amplify the chopped second signal to suitable a gain.

[0046] Once the desired amount of gain is achieved at the higher frequency (f1) for the first signal, the signal acquisition system 100 is configured to translate the amplified first signal back to its original frequency by applying second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system 100 is configured to translate first signal back its original frequency by demodulating the first signal with frequency f1. Once the desired amount of gain is achieved at the higher frequency (f1), the signal acquisition system 100 can be configured to translate the amplified second signal to a lower frequency which is other than its baseband, by applying the second level of chopping. In an embodiment, during second level of chopping, the signal acquisition system 100 is configured to translate the second signal by demodulating the second signal with a different frequency (f2) other than the first frequency (f1).

[0047] After applying second level of chopping at both the signals, the signal acquisition system 100 is further configured to combine the two chopped signals and create a single signal. Now, the filter 102 is configured to filter the combined signal to remove noise and harmonics that are added to the signals during the first level of chopping and the second level of chopping. Finally, the ADC 103 is configured to convert the combined analog signal to digital signal.

[0048] FIG. 4 is a flow diagram illustrating a method 400 for processing different signals together in a single circuitry using multi-frequency chopping using the example configuration of the FIG. 3, as disclosed in the embodiments herein. In an embodiment. at step 402, the method 400 includes receiving a plurality of input signals (for example: a first signal and a second signal) from signal sources. For example, the method 400 allows the plurality of sensors to receive plurality of signals. The signal acquisition system 100 receives the signals (the first signal and the second signal) and processes them together in a single circuitry using the multi-frequency chopping. At step 404, the method 400 includes applying first level of chopping to the first signal and the second signal. The method 400 allows the signal acquisition system 100 to translate the first signal and the second signal to higher frequencies by chopping (modulating) the signals with a higher frequency (f1). At step 406, the method 400 includes amplifying the chopped signals to achieve suitable gains. For example, the amplifier 101a and 101b is configured to amplify the chopped first signal and the chopped second signal respectively.

[0049] At step 408, the method 400 includes applying the second level of chopping for amplified first signal and second signal. During the second level of chopping, the method 400 allows the signal acquisition system 100 to translate the amplified signals to different frequencies other than frequencies used for first level of chopping by demodulating the first amplified signal and the second amplified signal with frequency f1 and f2 (other than f1) respectively. At step 410, the method 400 includes combining the chopped first signal and second signal to a single signal. At step 412, the method 400 includes filtering the combined signal for removing noise and harmonics that are added during first level of chopping and second level of chopping. The method 400 allows the signal acquisition system 100 to filter the combined signal by using the filter 102. At step 414, the method 400 includes sending the filtered signal to the ADC 103 for digitizing the signal. The method 400 allows the signal acquisition system 100 to digitize the combined signal by sending the signal to the ADC 103. The various acts, steps, operations, and actions in the method 400 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some of the acts, steps, operations, and actions may be omitted or modified without departing from the scope of the invention.

[0050] FIGS. 5a-5o depicts example graphs using the example configuration of the FIG. 3, as disclosed in the embodiments herein. It should be noted that the example graphs provided in the figures are diagrammatic and not to scale. In all the graphs, Y –axis represents the magnitude of the signal in dB while the X-axis represents the frequency in Hz where S (f) represents the power spectral density of the signal and N (f) represents the Noise spectral density.

[0051] In the FIG. 5a, the graph depicts a baseband input signal (S1) with very low frequency and low amplitude.

[0052] In the FIG. 5b, the graph depicts the input signal (S1) after first level of chopping. As the chopping involves translating signal to a higher frequency (f1), the input signal shifts to the higher frequency (f1). The graph also shows the harmonics of the input signal (S1).

[0053] In the FIG. 5c, the graph depicts the noise spectral density of noise that is added during the amplification of the input signal (S1) using a chopper amplifier. It is shown in the graph that at higher frequencies, the effect of noise is low and constant.

[0054] In the FIG. 5d, the graph depicts chopped input signal (S1) after amplification along with its harmonics.

[0055] In the FIG. 5e, the graph depicts a baseband input signal (S2) with very low frequency and low amplitude.

[0056] In the FIG. 5f, the graph depicts the input signal (S2) after first level of chopping. As the chopping involves translating signal to some higher frequency, the input signal shifts to a higher frequency (same frequency which is used for signal (S1) i.e., f1). The graph also shows the harmonics of the input signal (S2).

[0057] In the FIG. 5g, the graph depicts the noise spectral density of noise that is added during the amplification of the input signal (S2) using a chopper amplifier. It is shown in the graph that at higher frequencies, the effect of noise is low and constant.

[0058] In the FIG. 5h, the graph depicts chopped input signal (S2) after amplification along with its harmonics.

[0059] In the FIG. 5i, the graph depicts the input signal (S1) after second level of chopping with frequency which is used at first level of chopping (f1). Hence, the input signal (S1) shifts back to its original frequency after second level of chopping. This also shows harmonics that are obtained after second level of chopping.

[0060] In FIG. 5j, the graph depicts noise spectral density of the input signal (S1) after second level of chopping.

[0061] In the FIG. 5k, the graph depicts the input signal (S2) after second level of chopping (which is a different frequency when compared with the frequency used at the first level of chopping). Hence, after second level o0f chopping, the input signal (S2) is not shifted to the baseband but to a different frequency.

[0062] In the FIG. 5l, the graph depicts noise spectral density of the input signal (S2) after second level of chopping.

[0063] In the FIG. 5m, the graph depicts final summed signal (S) of the input signal (S1) and input signal (S2) after second level of chopping along with their harmonics.

[0064] In the FIG. 5n, the graph depicts the noise spectral density after summing the input signal (S1) and input signal (S2).

[0065] In the FIG. 5o, the graph depicts the filtered signal of the combined input signal (S1) and the input signal (S2). After filtration the additional harmonics and noise are eliminated from the signal.

[0066] FIG. 6 illustrates another example configuration of the signal acquisition system using the multi-frequency chopping, as disclosed in the embodiments herein. In this configuration, the signal acquisition system 100 is configured to include a first level chopping, an amplifier 101, a second level chopping, a filter 102 and an ADC 103.

[0067] In an embodiment, the signal acquisition system 100 is configured to receive two input signals i.e., signal 1 (first signal) and signal 2 (second signal) and process the two signals in a single circuitry by using multi-frequency chopping. For example, the single 1 is an ECG signal and signal 2 is an EMG signal. The signal acquisition system 100 is further configured to apply the first level of chopping to translate the first signal and the second signal to higher frequencies. In an embodiment, the first level of chopping can be applied by modulating each signal (i.e., the first signal and the second signal) with different higher frequencies (f1 and f2). As a result, the first signal and the second signal are shifted to different higher frequencies where the noise is low and the effects of DC offset are absent. In an embodiment, the filter 102 is configured to filter the noise from the first and the second signals after the first level of chopping.

[0068] Now, the signal acquisition system 100 is configured to combine the chopped first signal and the second signal into a single signal. . In an embodiment, the amplifier 101 is configured to amplify the combined signal with suitable gain. Once the gain is achieved, the signal acquisition system 100 is configured to apply the second level of chopping.

[0069] In an embodiment, the second level of chopping can be done to translate the amplified signal to the lower frequency by demodulating the signal with either frequency f1 or f2. Now, the filter 102 is configured to filter the signal to remove noise and harmonics that are added to the signals during the first level of chopping and the second level of chopping. Finally, the ADC 103 is configured to convert the combined analog signal to digital signal.

[0070] FIG. 7 is a flow diagram illustrating a method 700 for processing different signals together in a single circuitry using multi-frequency chopping using the example configuration of the FIG. 6, as disclosed in the embodiments herein. In an embodiment, at step 702, the method 700 includes acquiring plurality of input signals (for example: a first signal and a second signal) from signal sources. For example, plurality of sensors is configured to acquire plurality of signals. In an embodiment, the signal acquisition system 100 is configured to acquire input signals (the first signal and the second signal) and process them together in a single circuitry using a multi-frequency chopping.

[0071] At step 704, the method 700 includes applying the first level of chopping to the first signal and second signal. The method 700 allows the signal acquisition system 100 to translate the first signal and the second signal to higher frequencies. The first level of chopping can be applied by modulating each signal (i.e., the first signal and the second signal) with different higher frequencies (f1 and f2). At step 706, the method 700 includes combining the chopped signals to a single signal. The method 700 allows the signal acquisition system 100 to combine the chopped first signal and the second signal into a single signal.

[0072] At step 708, the method 700 amplifying the combined signal. The method 700 allows the amplifier 101 to amplify the combined signal with suitable gain. At step 710, the method 700 includes applying the second level of chopping to the amplified signal. The method 700 allows the signal acquisition system 100 to translate the amplified signal to the lower frequency by demodulating the signal with either f1 or f2. At step 712, the method 700 includes filtering the chopped signal. The method 700 allows the filter 102 to filter the signal to remove noise and harmonics that are added to the signals during the first level of chopping and the second level of chopping. At step 714, the method 700 includes sending the filtered signal to the ADC 103. The method 700 allows the ADC 103 to convert the combined analog signal to digital signal.

[0073] The various acts, steps, operations, and actions in the method 700 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some of the acts, steps, operations, and actions may be omitted or modified without departing from the scope of the invention.

[0074] FIGS. 8a- 8j depict graphs in accordance with the FIG. 6. It should be noted that the example graphs provided in the figures are diagrammatic and not to scale. In all the graphs, Y –axis shows the magnitude of the signal while the X-axis represents the frequency in Hz where, S (f) represents the power spectral density of the signal and N (f) represents the Noise spectral density.

[0075] In the FIG. 8a, the graph depicts a baseband input signal (S1) with very low frequency and low amplitude.

[0076] In the FIG. 8b, the graph depicts the input signal (S1) after first level of chopping. As the chopping involves translating signal to a higher frequency (f1), the input signal shifts to the higher frequency (f1). The graph also shows the harmonics of the input signal (S1).

[0077] In the FIG. 8c, the graph depicts a baseband input signal (S2) with very low frequency and low amplitude.

[0078] In the FIG. 8d, the graph depicts the input signal (S2) after first level of chopping. As the chopping involves translating signal to some higher frequency (f2), the input signal shifts to a higher frequency (f2). The graph also shows the harmonics of the input signal (S2).

[0079] In the FIG. 8e, the graph depicts combined signal (S) after combining both the chopped input signal (S1) and the input signal (S2).

[0080] In the FIG. 8f, the graph depicts the noise spectral density of noise added during the amplification.

[0081] In the FIG. 8g, the graph depicts the signal obtained after amplifying the summed signal.

[0082] In the FIG. 8h, the graph depicts the signal obtained after chopping the amplified signal for second level along with their harmonics. Hence, the combined signal is shifted back to original frequency.

[0083] In the FIG. 8i, the graph depicts noise spectral density after second level of chopping.

[0084] In the FIG. 8j, the graph depicts the filtered signal of the combined input signal. From the graph, it is shown that after filtration the additional harmonics and noise are eliminated.

[0085] FIGS. 9a-9g depicts example simulation graphs using the example configuration of the FIG. 3, as disclosed in the embodiments herein. In all the simulation graphs, X-axis represents the frequency and Y-axis represents magnitude in dB.

[0086] In the FIG. 9a, the simulation graph depicts an input signal (S1) in frequency domain.

[0087] In the FIG. 9b, the simulation graph depicts another input signal

(S2) in frequency domain.

[0088] In the FIG. 9c, the simulation graph depicts the input signal (S1) after chopping with frequency 2 kHz for first time (first level of chopping). Hence, the input signal is translated to the high frequency (f1) 2 kHz.

[0089] In the FIG. 9d, the simulation graph depicts the input signal (S2) after chopping with frequency 2 kHz for first time (first level of chopping). Hence, the input signal is translated to the high frequency (f1) 2 kHz.

[0090] In the FIG. 9e, the simulation graph depicts the amplified input signal (S1) after chopping with frequency 2 kHz for second time (second level of chopping). Hence, the input signal is translated back to its original frequency.

[0091] In the FIG. 9f, the simulation graph depicts the amplified input signal (S2) after chopping with frequency 2.1 kHz (different frequency when compared to first level of chopping) for second time. Hence, the input signal is translated back to a new lower frequency (i.e., 100 Hz) but not to its baseband.

[0092] In the FIG. 9g, the simulation graph depicts the final signal that is obtained after summing the two signals (input signal S1 and input signal S2) after second level of chopping.

[0093] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the network elements.

[0094] The embodiment disclosed herein specifies a system and method for processing different signals together in a single circuitry during signal acquisition. The mechanism allows using a multi-frequency chopping providing a system thereof.

[0095] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the claims as described herein.

## CLAIMS

We claim:

1. A method to process a plurality of signals together in a single circuitry using a multi-frequency chopping, the method comprising:

   receiving said plurality of signals from a plurality of channels; and

   applying a second level of chopping to said received plurality of signals in at least one second frequency other than a first frequency, wherein said second level of chopping is applied after a first level of chopping using said first frequency, wherein applying said first level of chopping and said second level of chopping processes said plurality of signals together in said single circuitry.

2. The method of claim 1, wherein said method further comprises amplifying said received plurality of signals before applying said second level of chopping.

3. The method of claim 1, wherein said method further comprises:

   combining said plurality of chopped signals to create a single signal;

   filtering said created single signal; and

   sending said single signal to an Analog-to-Digital Converter

(ADC).

4. The method of claim 1, wherein said method further comprises:

applying said first level of chopping to said received plurality of signals in one of: said first frequency, said second frequency; wherein said received plurality of signals are amplified after said first level of chopping;

applying said second level of chopping to said amplified plurality of signals in said first frequency and said at least one second frequency;

combining said plurality of chopped signals to create said single signal;

filtering said created single signal; and

sending said single signal to said ADC.

5. The method of claim 1, wherein said method further comprises:

applying said first level of chopping to said received plurality of signals in said first frequency and said at least one second frequency;

combining said plurality of chopped signals to create said single signal after said first level of chopping;

amplifying said single signal;

applying said second level of chopping to said amplified single signal in one of: said first frequency, said second frequency;

filtering said chopped single signal; and

sending said single signal to said ADC.

6. A system for processing a plurality of signals together in a single circuitry using a multi-frequency chopping, the system comprises at least one chopper amplifier, a filter, an Analog to Digital Converter (ADC), wherein said system is configured to:

receive said plurality of signals from a plurality of channels; and

apply a second level of chopping to said received plurality of signals in at least one second frequency other than a first frequency, wherein said second level of chopping is applied after a first level of chopping using said first frequency, wherein applying said first level of chopping and said second level of chopping processes said plurality of signals together in said single circuitry.

7. The system of claim 6, wherein said system is further configured to amplify said received plurality of signals before applying said second level of chopping by said at least one chopper amplifier.

8. The system of claim 6, wherein said system is further configured to:

combine said plurality of chopped signals to create a single signal;

filter said created single signal by said filter; and

send said single signal to an Analog-to-Digital Converter (ADC).

9. The system of claim 6, wherein said system is further configured to:

apply said first level of chopping to said received plurality of signals in one of: said first frequency, said second frequency, wherein said received plurality of signals are amplified after said first level of chopping by said at least one chopper amplifier;

apply said second level of chopping to said amplified plurality of signals in said first frequency and said at least one second frequency;

combine said plurality of chopped signals to create said single signal;

filter said created single signal by said filter; and

send said single signal to said ADC.

10. The system of claim 6, wherein said system is further configured to:

apply said first level of chopping to said received plurality of signals in said first frequency and said at least one second frequency;

combine said plurality of chopped signals to create said single signal after said first level of chopping;

amplify said single signal by said chopper amplifier;

apply said second level of chopping to said amplified single signal in one of: said first frequency, said second frequency;

filter said chopped single signal by said filter; and

send said single signal to said ADC.

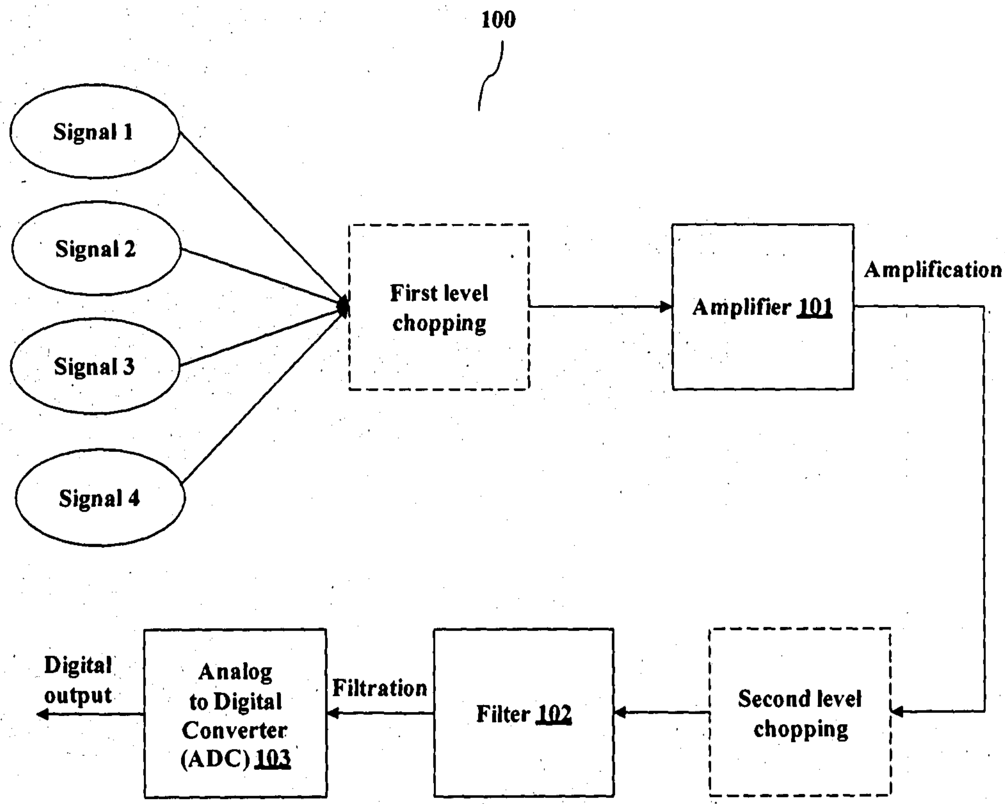

100
Signal 1
Signal 2
Signal 3
Signal 4
First level chopping
Amplifier 101
Amplification
Second level chopping
Filter 102
Filtration
Analog to Digital Converter (ADC) 103
Digital output

FIG. 1

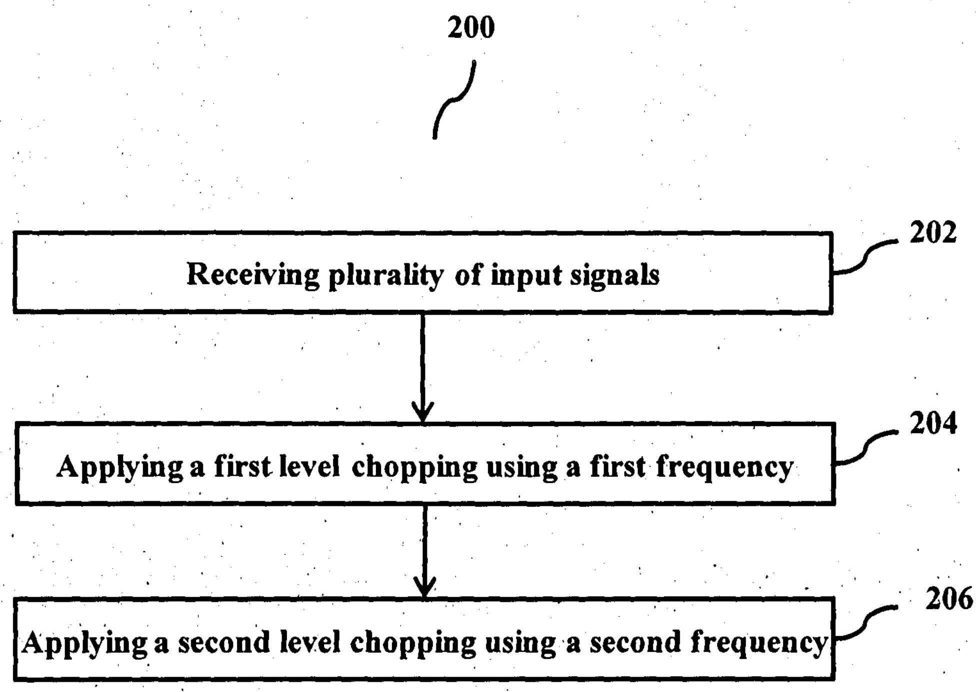

200
Receiving plurality of input signals
202
Applying a first level chopping using a first frequency
204
Applying a second level chopping using a second frequency
206

FIG. 2

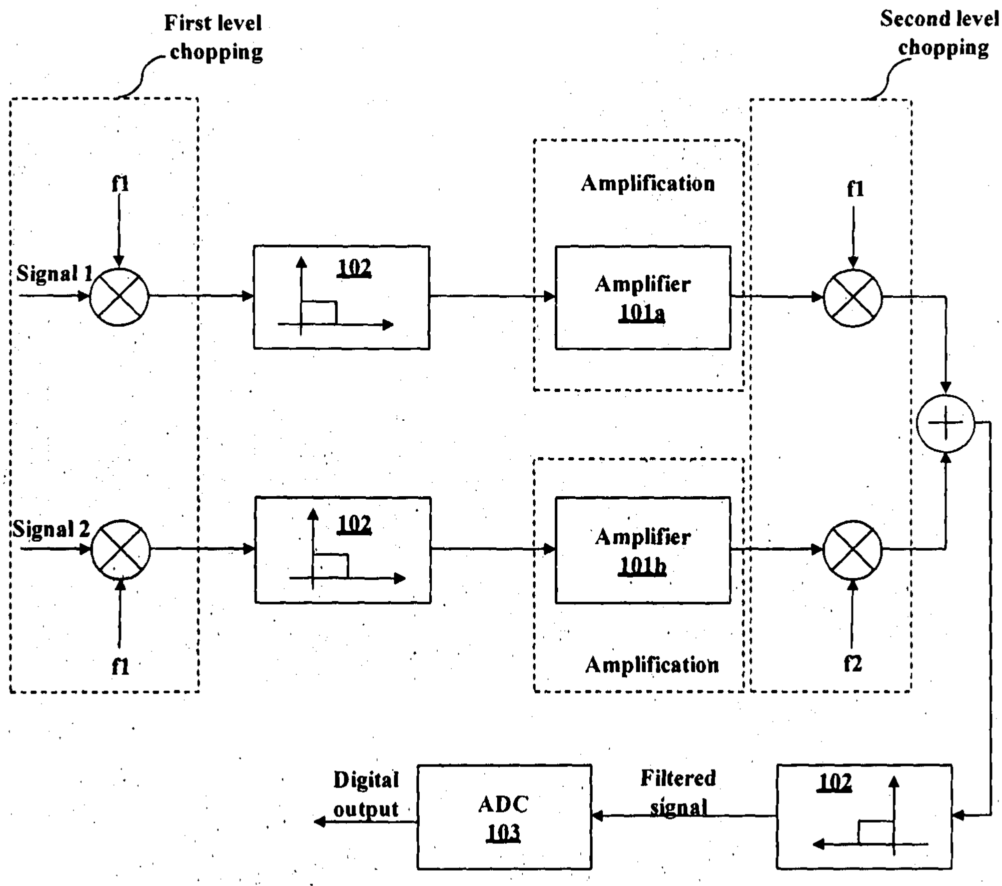

First level chopping
Second level chopping
Amplification
f1
f1
Signal 1
102
Amplifier
101a
Signal 2
102
Amplifier
101b
f1
Amplification
f2
Digital output
ADC
103
Filtered signal
102

FIG. 3

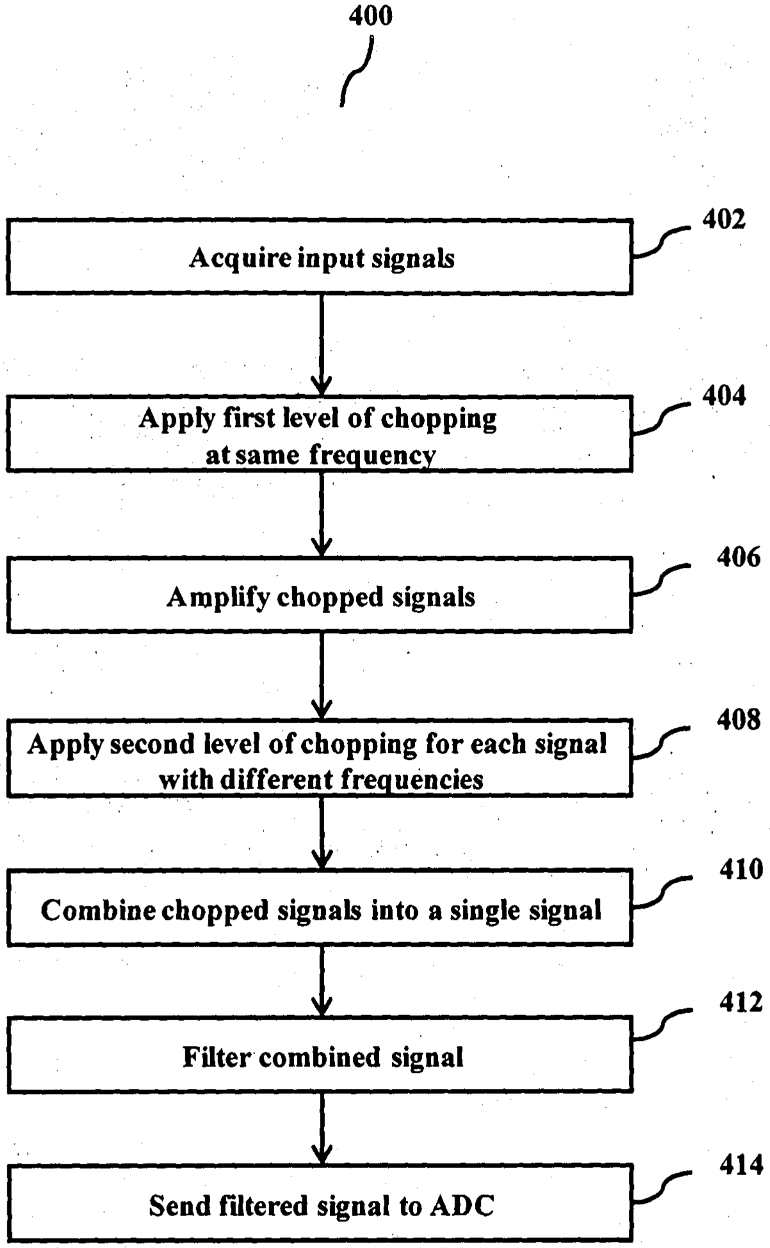

400
Acquire input signals
402
Apply first level of chopping at same frequency
404
Amplify chopped signals
406
Apply second level of chopping for each signal with different frequencies
408
Combine chopped signals into a single signal
410
Filter combined signal
412
Send filtered signal to ADC
414

FIG. 4

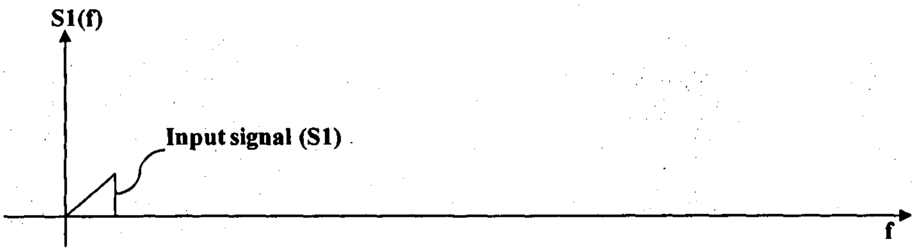



FIG. 5a

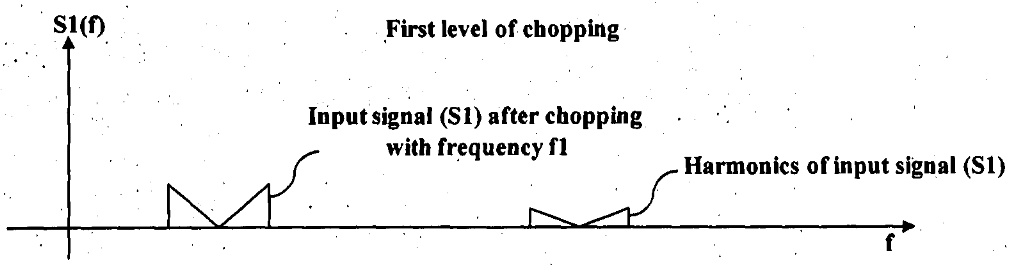



FIG. 5b

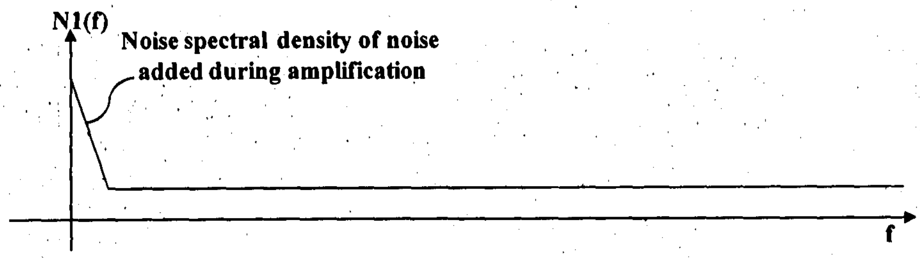



FIG. 5c

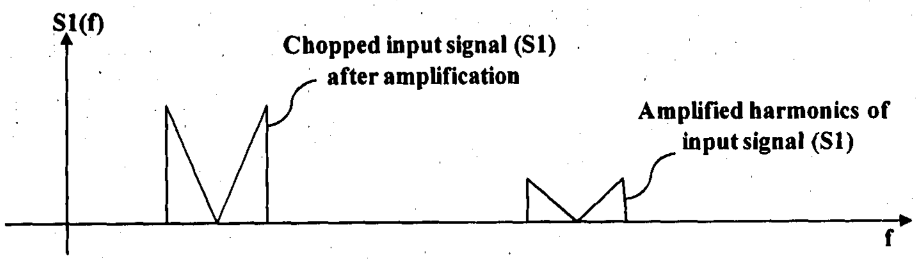



FIG. 5d

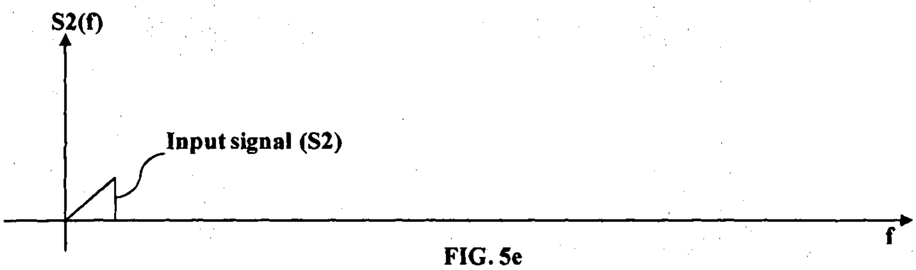



FIG. 5e

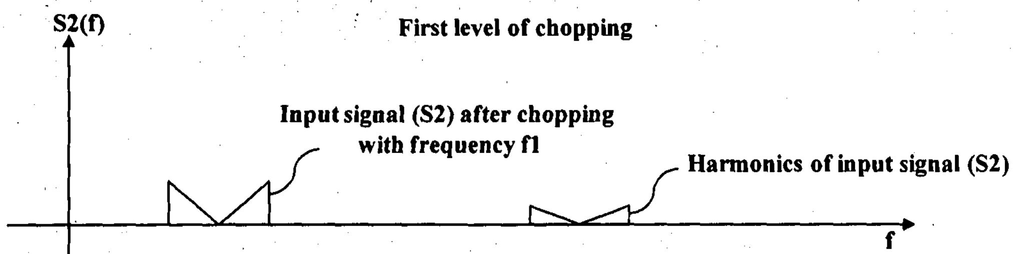



FIG. 5f

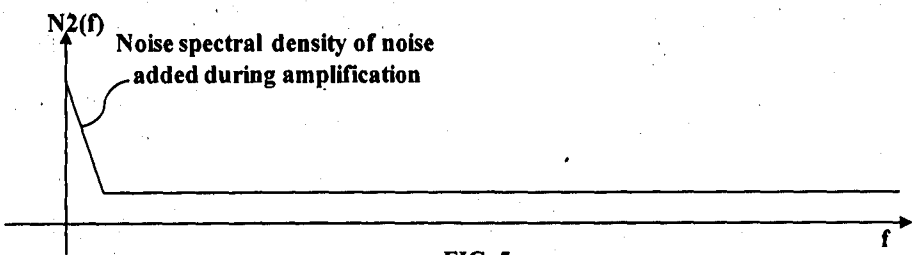



FIG. 5g

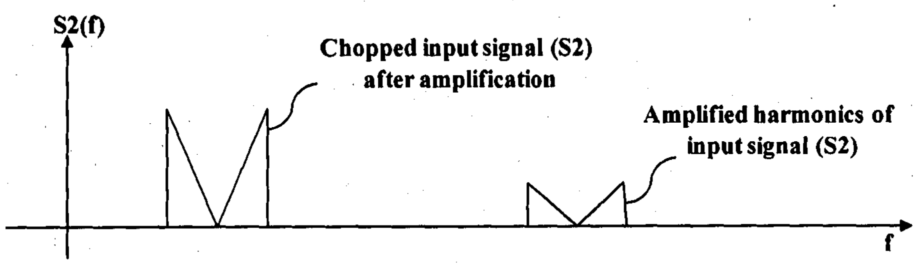



FIG. 5h

Second level of chopping

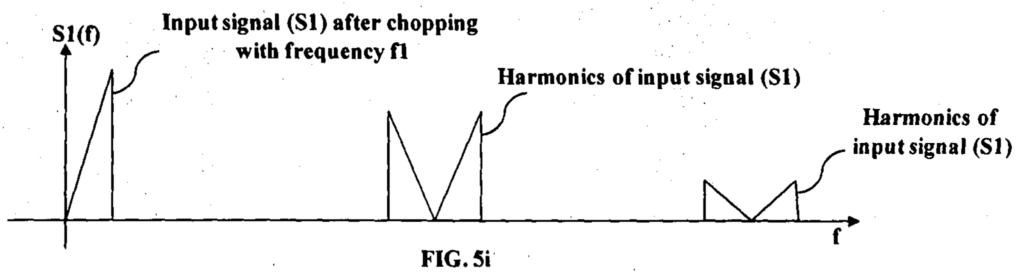



FIG. 5i

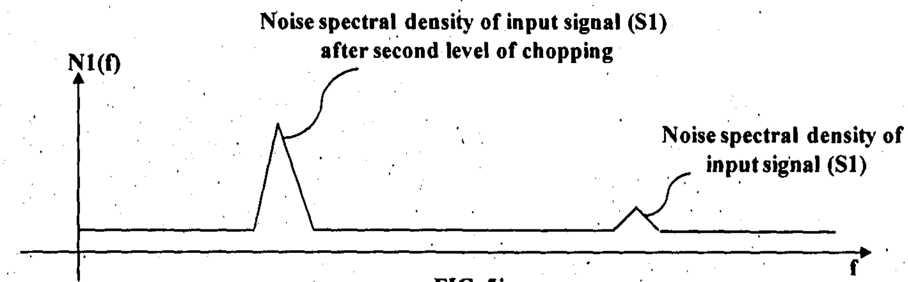



FIG. 5j

Second level of chopping

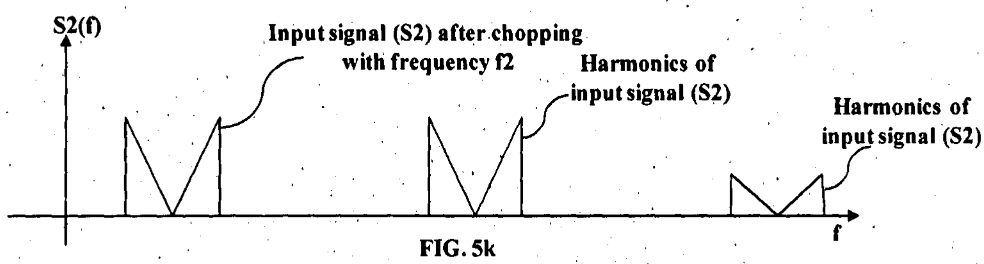



FIG. 5k

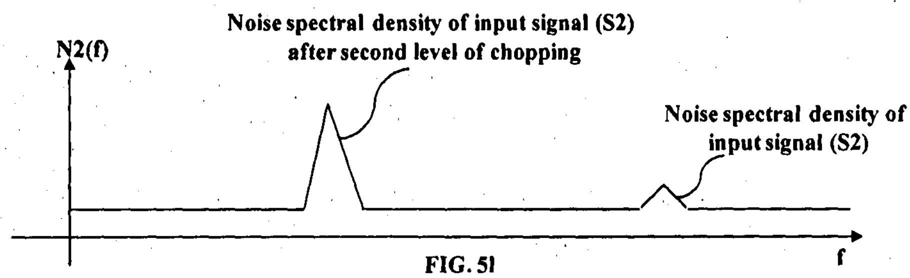



FIG. 5l

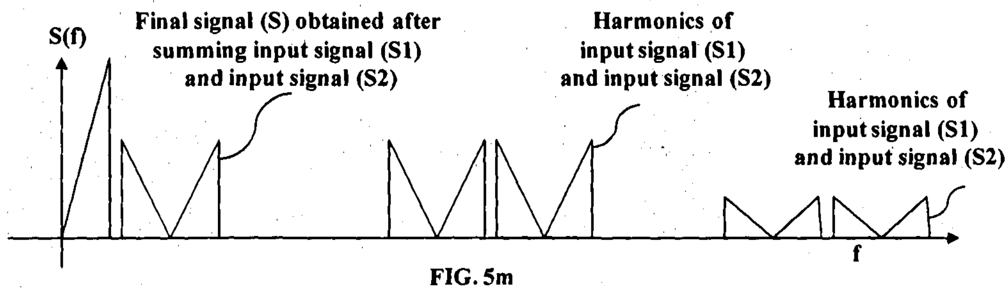


FIG. 5m

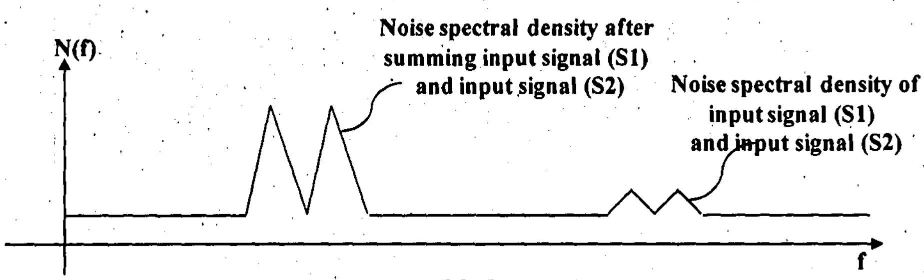


FIG. 5n

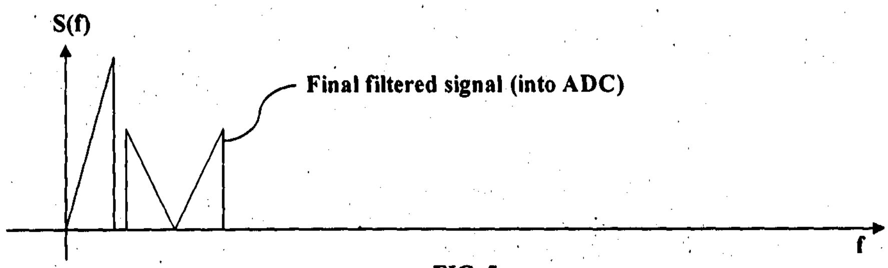


FIG. 5o

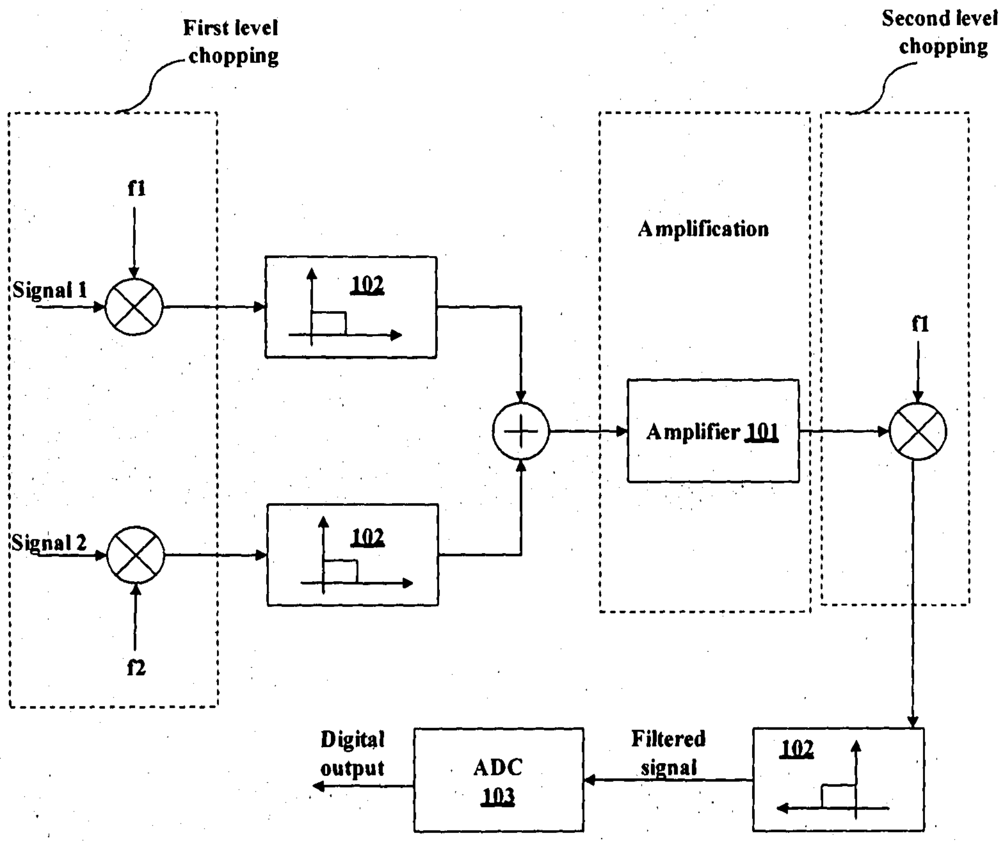

First level chopping
Second level chopping
f1
Signal 1
102
Amplification
f1
Amplifier 101
Signal 2
102
f2
Digital output
ADC 103
Filtered signal
102

FIG. 6

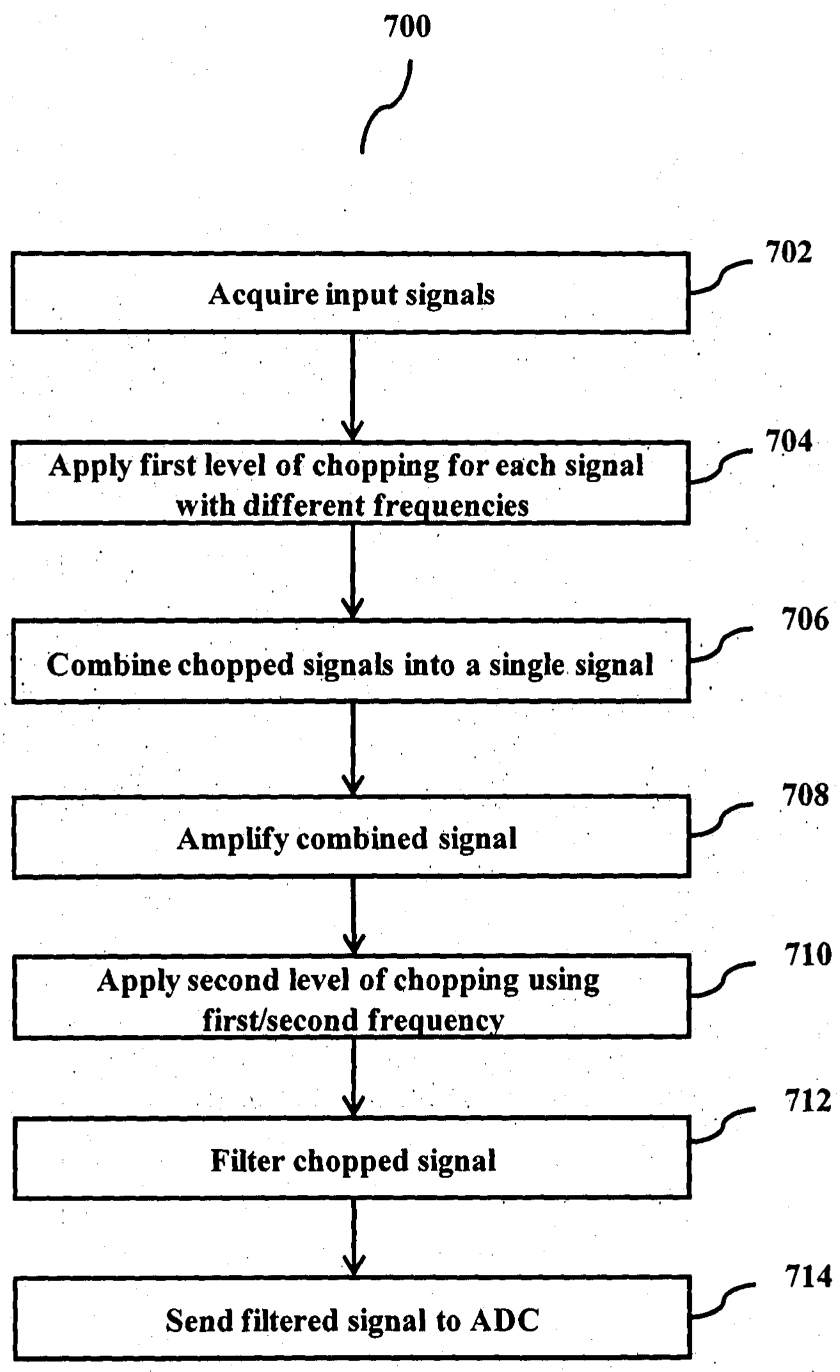

700
702
Acquire input signals
704
Apply first level of chopping for each signal with different frequencies
706
Combine chopped signals into a single signal
708
Amplify combined signal
710
Apply second level of chopping using first/second frequency
712
Filter chopped signal
714
Send filtered signal to ADC

FIG. 7

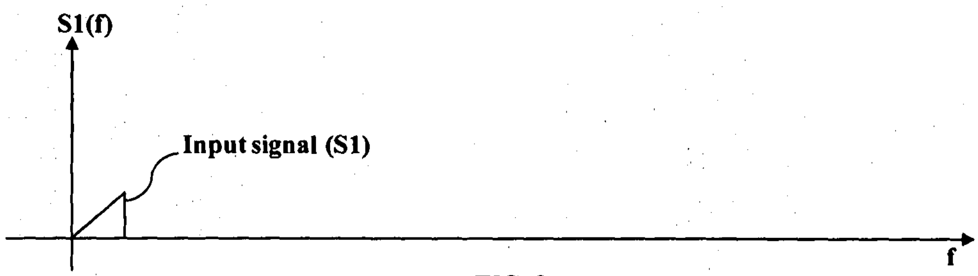



FIG. 8a

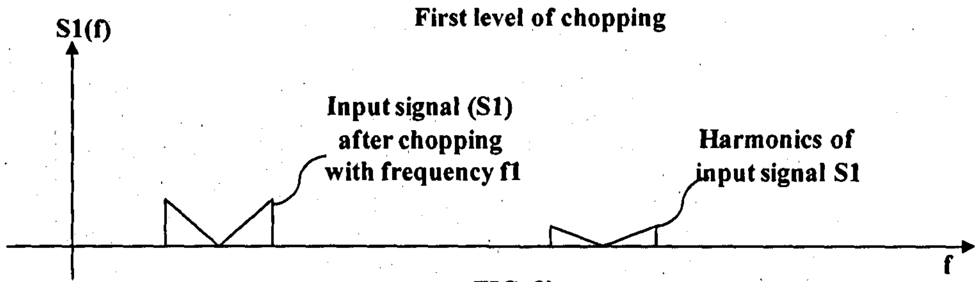



FIG. 8b

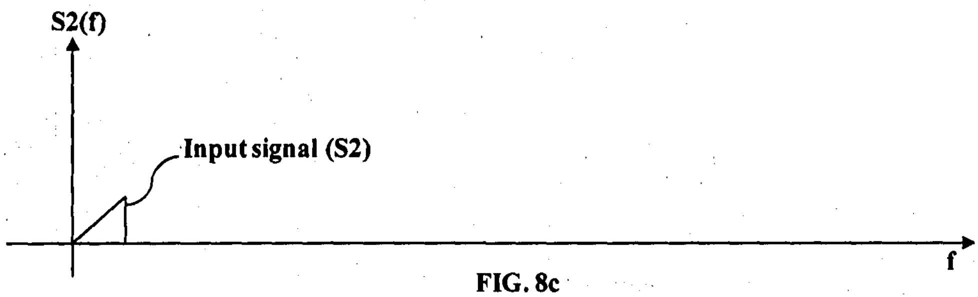



FIG. 8c

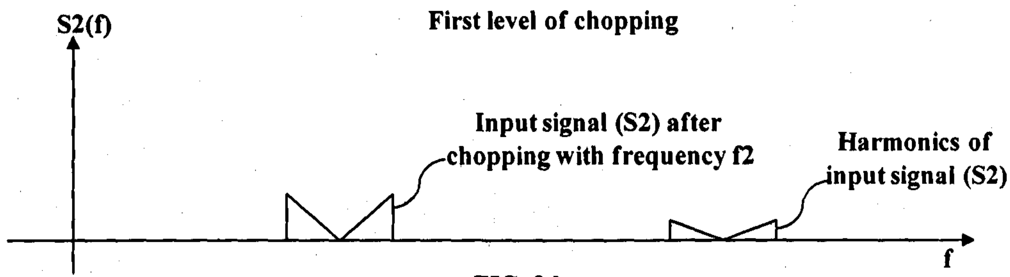



FIG. 8d

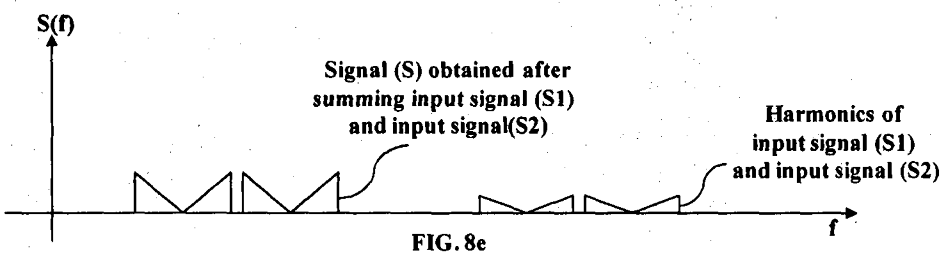



FIG. 8e

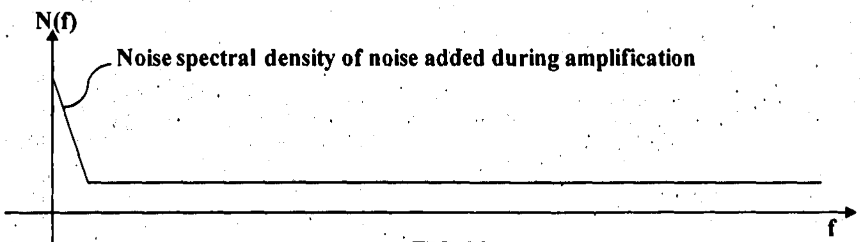



FIG. 8f

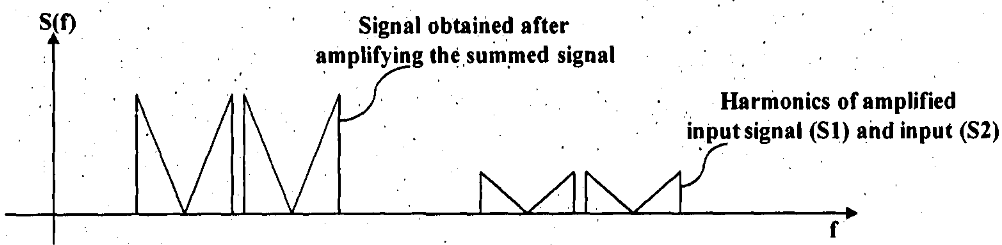



FIG. 8g

Second level of chopping

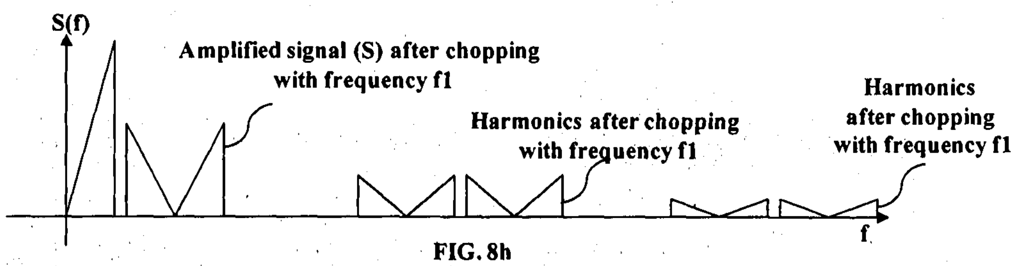



FIG. 8h

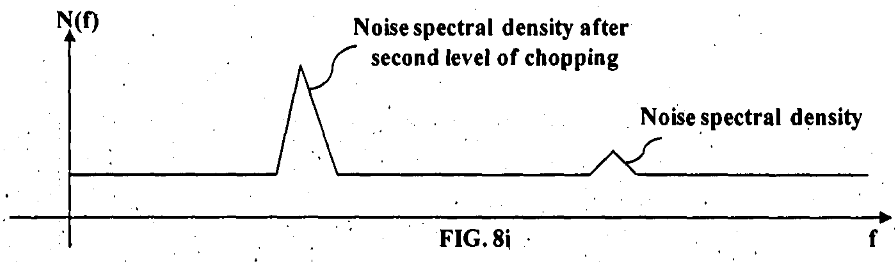



FIG. 8i

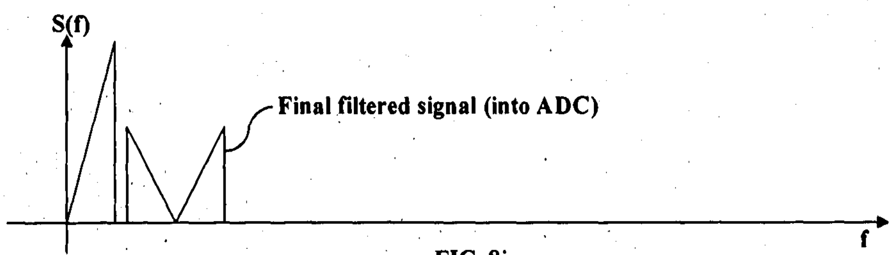



FIG. 8j

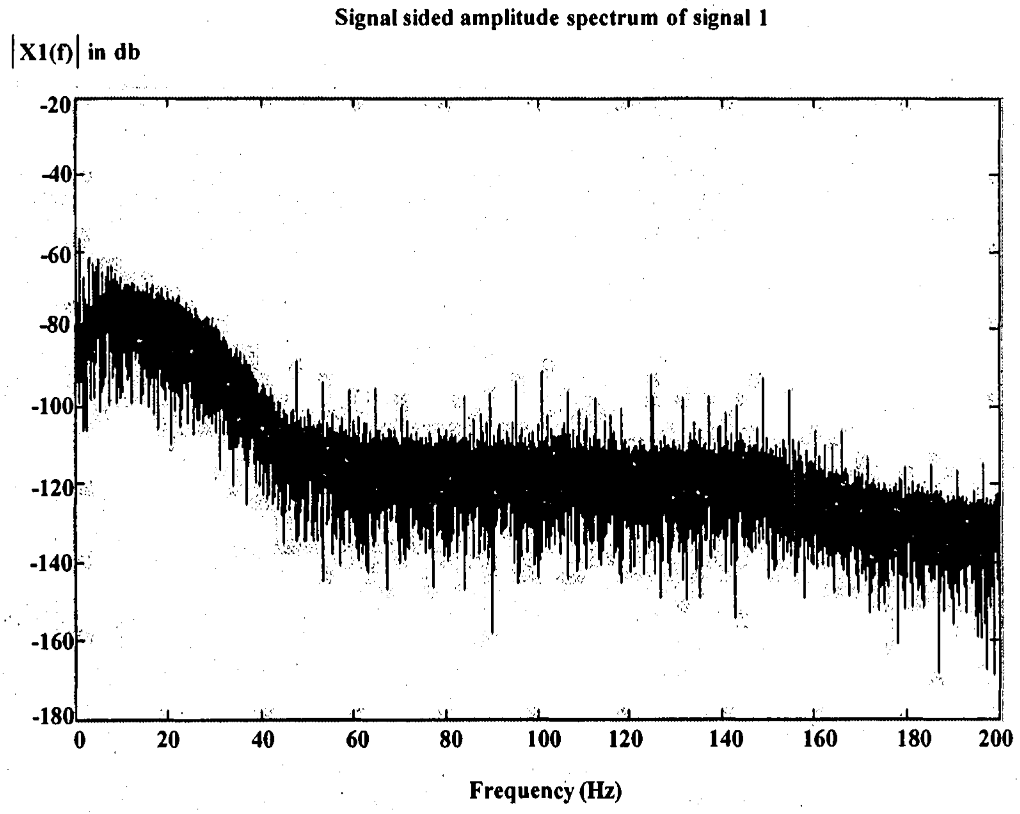

Signal sided amplitude spectrum of signal 1
|X1(f)| in db
-20
-40
-60
-80
-100
-120
-140
-160
-180
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)

FIG. 9a

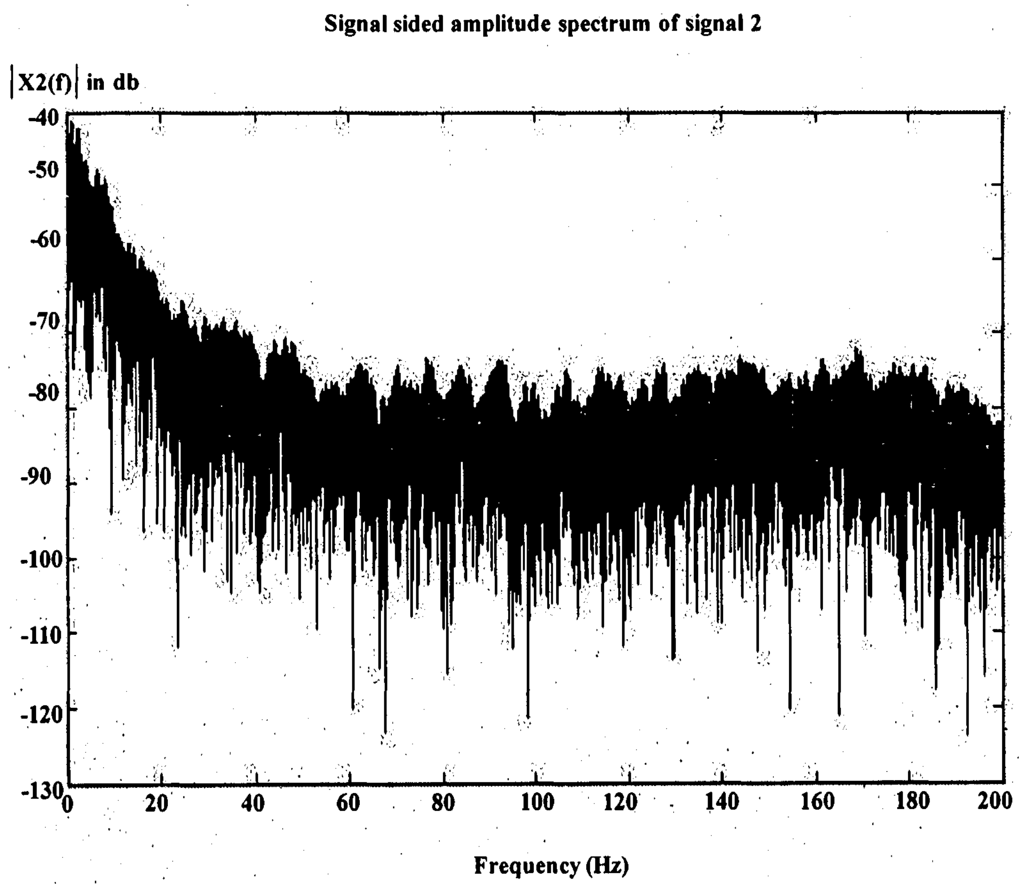

Signal sided amplitude spectrum of signal 2
|X2(f)| in db
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)

FIG. 9b

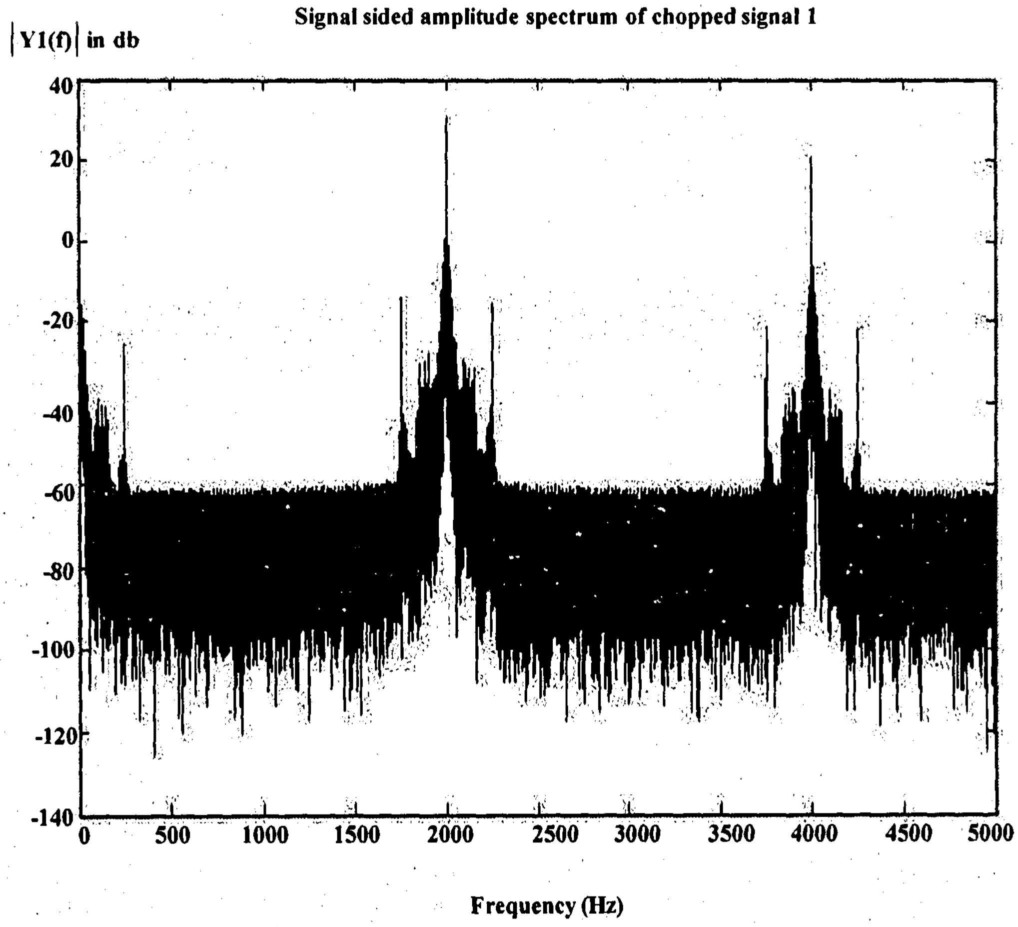

Signal sided amplitude spectrum of chopped signal 1
|Y1(f)| in db
40
20
0
-20
-40
-60
-80
-100
-120
-140
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Frequency (Hz)

FIG. 9c

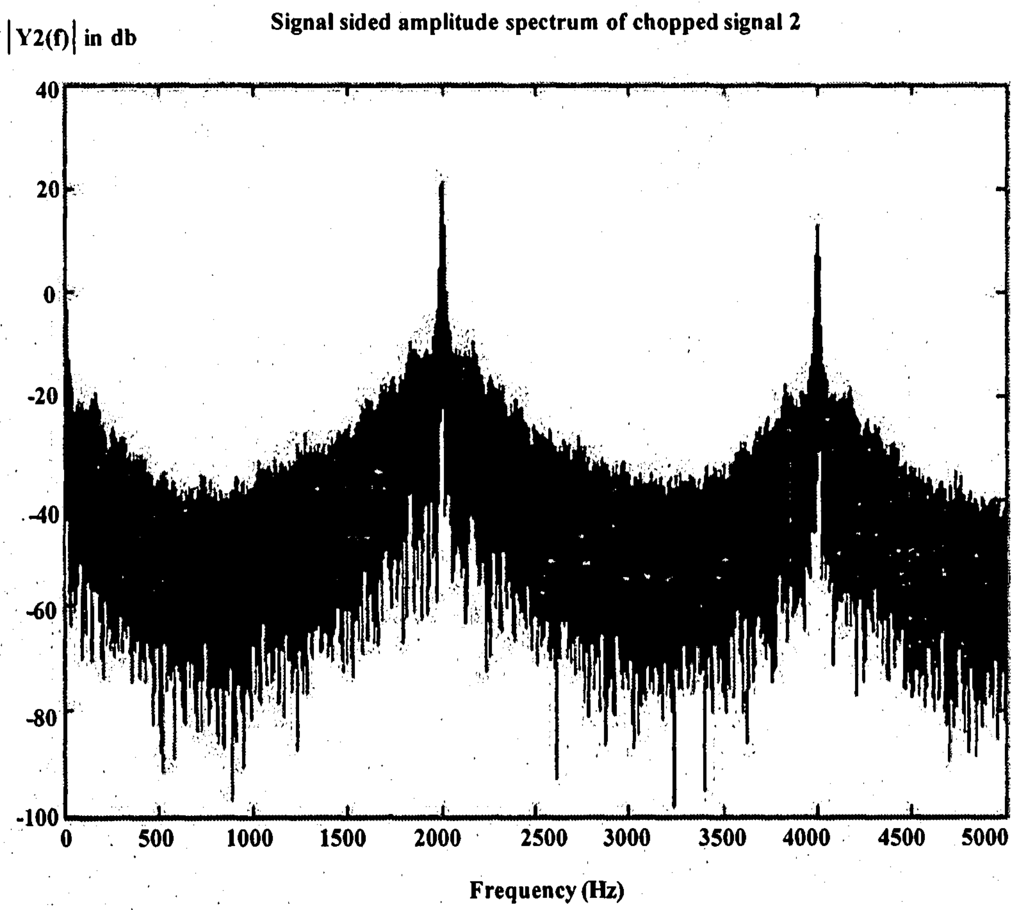

|Y2(f)| in db
Signal sided amplitude spectrum of chopped signal 2
40
20
0
-20
-40
-60
-80
-100
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Frequency (Hz)

FIG. 9d

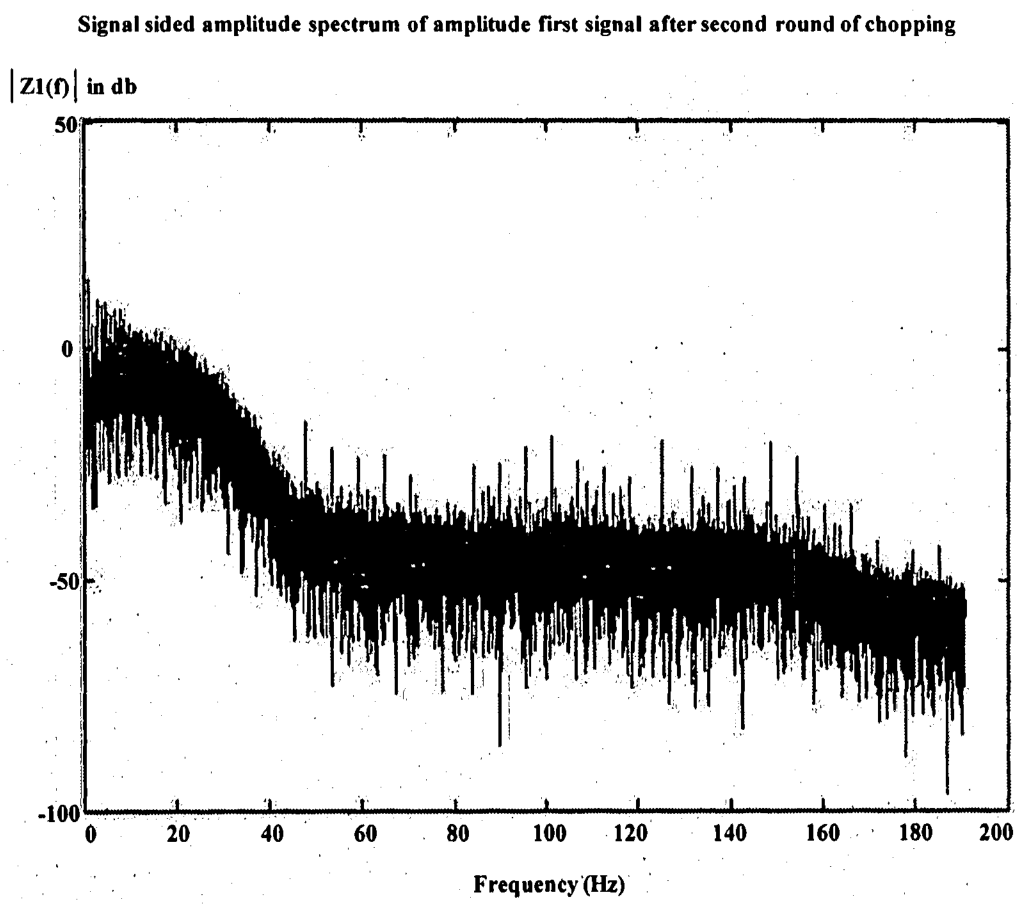

Signal sided amplitude spectrum of amplitude first signal after second round of chopping
|Z1(f)| in db
50
0
-50
-100
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)

FIG. 9e

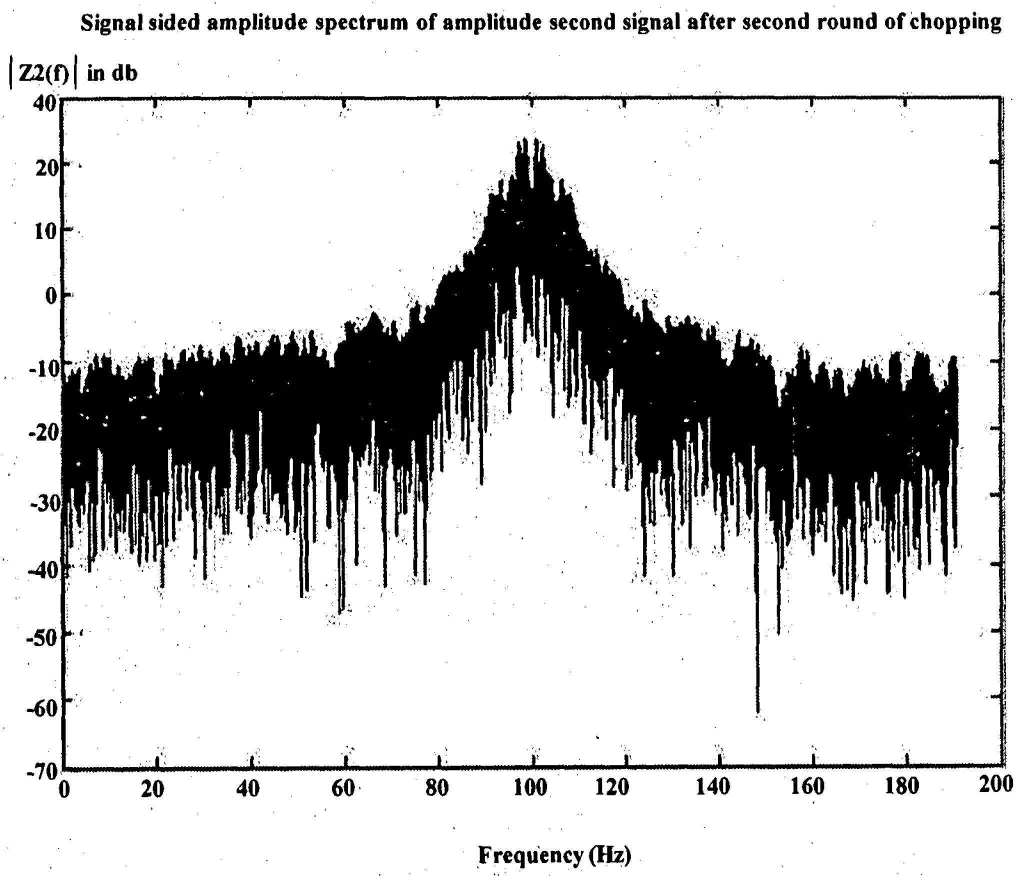
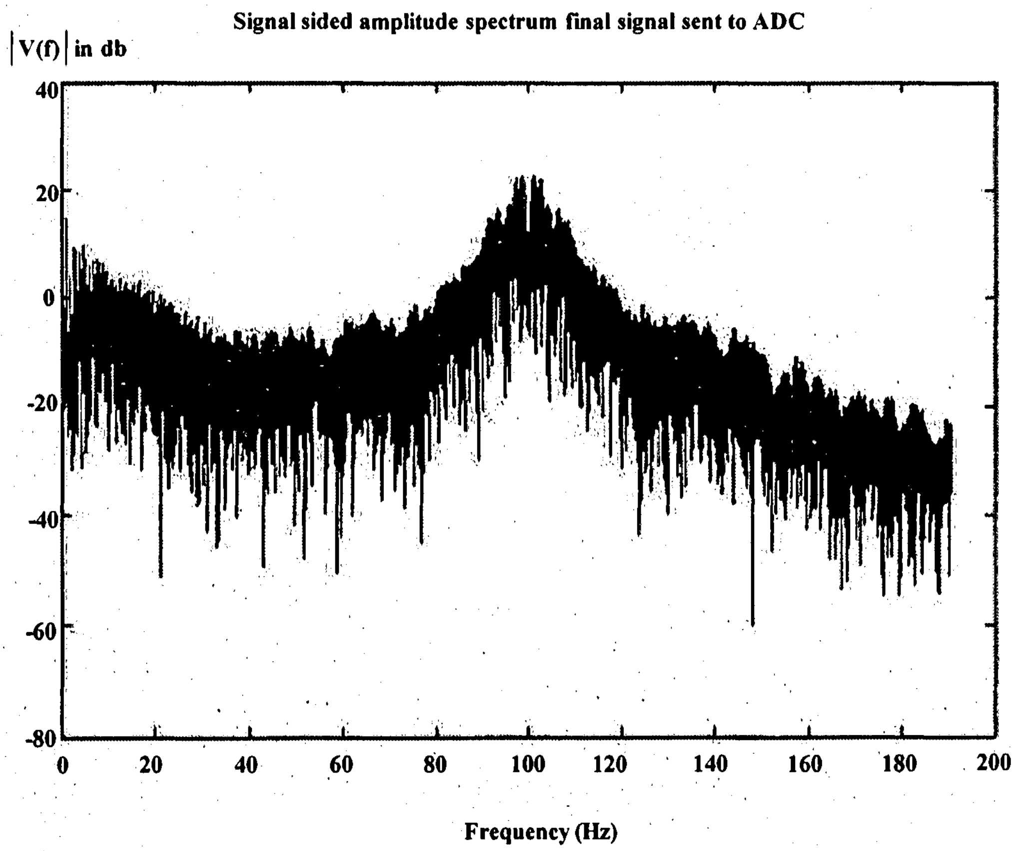

Signal sided amplitude spectrum of amplitude second signal after second round of chopping
|Z2(f)| in db
40
20
10
0
-10
-20
-30
-40
-50
-60
-70
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)

FIG. 9f



Signal sided amplitude spectrum final signal sent to ADC
|V(f)| in db
40
20
0
-20
-40
-60
-80
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)


FIG. 9g