# Design of Delayed Auditory Feedback for analysing Dysfluent Speech samples

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***Abstract*- The originate characteristic feature of the Delayed auditory feedback is to deliver altered auditory feedback which is described for applications who suffer from dysfluency. The programming of the DAF device is achieved through a personal computer by using matlab software tool. It is a technique by which the original acoustic speech signal is exaggeratedly altered and then fed back via Head phone. Speech performance deteriorates if a delay is introduced among the time when speakers speak a sound and when they hear it (DAF). DAF increases the fluency of the input speech by reducing the rate of speech with providing delay and removing the repeated speech. The delay produces the noticeable effect are between 0-300ms.**

***Index Terms*- delay; auditory; speech disorders; speech perception.**

## I. INTRODUCTION

Delayed auditory feedback (DAF), also called delayed side-tone, is a type of altered auditory feedback along with frequency altered feedback that consists of extending the time between speech and auditory perception. It consist of device that enables a user to speak in to a microphone and then hear the voice in headphones a fraction of second later. Its effects are slowing of speech which can result in increased fluency of the input voice. DAF used to demonstrate the significance of auditory feedback in speech perception as well as in speech production. It has the capability of white noise masking, used to treat any dysfluency.

DAF is a technique by which the original acoustic speech signal is artificially modified and then fed back via Head phone. It is the process of playing back one's own speech after brief time delay in order to study the role of auditory feedback in the control of speech production.

Direct effects of DAF include mispronunciations, omissions and omitted word endings. Indirect effects of DAF include reduction in rate of speech, increase in intensity and increase in fundamental frequency in order to disable the effects of the feedback.

In general, more rapid, fluent speakers are little affected by DAF than slower, less fluent speakers. Also more rapid fluent speakers are maximally disrupted by shorter delay time, while slower speakers are maximally disrupted under longer delay times. DAF can also be used to support the fluency sharpening target of slow speech with stretched vowels. A shorter delay almost instantly reduces dysfluency without changing the speech speaking rate. A longer delay makes speech stretch vowels and talk slower. In children age 4-6 there is less disturbance of speech than children age 7-9 under a delay of 300ms. A 300ms delay produces maximum disruption for adults. As the data collected from these studies specifies, the delay required for maximum disruption decreases with age.

When the dysfluency speaker can complete a communication task such as counting to ten**,** using the slow speech target correctly, (e.g, all syllables stretched equally, all syllables stretched to one or two seconds and no pauses between words ) then we can use a DAF device to increase the length and increase the stress of the speaking situation.

The application of delayed auditory feedback make an attempt to improve speech communication with those suffering from speech and language communication disorders has been making progress for decades. Delayed auditory feedback has been widely utilized with a diversity of disorders including dysarthria, aphasia, Parkinson's disease, dyspraxia, and vocal tremor.

DAF is an effective means of reducing rate of speech stuttering even when employed as the only treatment approach outside a therapeutic environment. DAF continues to raise fluency when used over a longer period, but also that length of exposure and fluency enhancement are probably not in a linear relationship.

## II.PROBLEM STATEMENT

Consider any dysfluencies( complex speech disorder) that is not so easy to treat. According to WHO, the rhythm of speech in which the individual knows exactly what he or she wishes to say, but at the time is unable to say it because of an uncontrolled repetition, prolongation or cessation of a sound.

## III.OBJECTIVE

Speech rate is an in important index when analyzing the effectiveness of treatment, Since one of the goals of this project is to provide for the patient ,the ability to present the same speech pattern as that of individuals with no communication deficits i.e, such that the outpatient speech does not sound different from that of fluent speakers.

## IV.SOLUTION STRATEGY

In order to familiar with the dysfluencies, it is possible to implement DAF. Delayed auditory feedback can be used to make dysfluency does not sound different from that of fluent speakers by inducing a slower speaking rate i.e To make even severe dysflency nearly 80% fluent.

## V.LITERATURE SURVEY

- Havlicek proposed on musical sight-reading task, performances on representatives of each of the classifications of instruments, brass, woodwind, string, and piano, were significantly disrupted by DAF; the delay interval used was 0.12 sec. Bradshaw, Nettleton, and Geffen found a delay of 0.20 sec to be more disruptive to piano playing than the other delays tested in a pilot study. The same interval was also found to be disruptive in the playing of an electronic organ with DAF alone to one ear and immediate auditory feedback (IAF) alone to the other ear.
- Steven A. Finney explained about the auditory feedback and memory for music performance. The sound evidence for an encoding effectare discussed. The availability of auditory feedback was modified at both learning performance from notation and test performance from memory. The performance from memory of well-learned music showed little effect of removal of auditory feedback.
- Laurence Bostwick proposed on A low-cost solid state device for producing delayed auditory feedback. The regular auditory feedback from self composed speech is delayed, the normal individual usually experiences difficulty in speaking smoothly. Hence it has been used for the treatment of stuttering as well as other speech difficulties. This paper presents a implication for construction of a relatively low-cost solid state delayed auditory feedback device. The advantages of this unit are it is reliable, flexible, easy to operate, and it does not require audio tape.
- M.F.Dorman explained the delayed auditory feedback on phonation.the delayed auditory feedback alters the temporal pattern of laryngeal and supralaryngeal muscle activity. The amplitude of electromyographic(EMG) activity is also altered by DAF but changes in activity vary considerably between muscles and speakers.
- John L. Bradshaw et.al Explained on “Effect of different delayed auditory feedback intervals on a music performance task” the effects of 12 different delay intervals in a musical task involving performance on an electronic organ. Disruption was found to appear to a degree comparable to similar studies involving verbal and rhythmic tasks under DAF. Maximal disruption created with a delay of 0.27 sec, a value rather greater than that typically found to be most disruptive in speech.
- Paul Blanchet explained the analysis of Treat fluency and Speech Rate Deficits in Individuals with Parkinson’s Disease: Specific Clinical Considerations using delayed auditory feedback. The purpose of this related technical papers is to propose detailed clinical applications of delayed auditory feedback (DAF) in treating the speech rate and fluency defaults in speakers with Parkinson’s disease. For optimal results from DAF, clinicians should provide the narrator with instruction, modeling, and feedback. important clinical issues such as choosing effective delay intervals, trade-offs among speech rate and

intelligibility, and the "first word dilemma" will be considered.

- Michael P. Rastatter et. al worked on "Self-Contained In-the-Ear Device to Deliver Altered Auditory Feedback". Delayed auditory feedback and altered frequency feedback signals in combination or isolation can be generated to the user in a cosmetically appealing custom in the-canal and completely-in-the-design of the canal. Programming of the device is achieved through a personal computer, interface and fitting software.
- Douglas I.Katz and James R. Lackner explained on adaptation to delayed auditory feedback. Delayed auditory feedback disrupts the production of speech, causing an increase in speech duration as well as many errors in articulation . To determine whether prolonged exposure to DAF leads to adaptive compensations in speech production. Significant adaptation occurred for syntactically structured stimulus types in the form of increased speaking rates. In this study, adaptation to delayed auditory feedback was examined using exposure conditions of relatively prolonged durations.
- Teruki Toya and Daisuke Ishikawa Published a paper and they explained Study on Effects of Speech Production during Delayed Auditory Feedback for Bone-Conducted and Air-Conducted Speech. In this paper, speaking styles and performance under DAF for bone and air conducted speech were investigated. As a result, for both air- and bone-conducted presentation, speech duration was largely prolonged under 100-200ms delay. He also explained DAF for not only air-conducted but also bone-conducted speech would affect one's speech production.
- David M. Corey, Vishnu Anand Cuddapah published a paper and explained the Delayed auditory feedback effects during reading and conversation tasks: Gender differences in fluent adult. In this they explained DAF impacts the speech fluency of normally fluent males more than that of normally fluent females. Males also produced significantly more reading errors than females. DAF reduced speaking rate significantly more while reading than conversing. DAF significantly decreased the frequency of interjections and increases the frequency in articulation errors; however, no Gender effects on these variables were observed. Although significant order effects specifies improved fluency across trials, covariance analysis was explained.
- Howell and Alexandra Archer discussed about the performance of speech deteriorates if a delay is introduced between the time when speakers speak a sound and when they hear it in DAF. Not all speakers are equally susceptible to the effects of DAF. The hypothesis examined here is that degradation in performing a serially organized behavior such as speech occurs when a rhythmic event goes on concurrent along with out of synchrony with the activity. Different susceptibility to the effects of DAF can be accounted for by this hypothesis due to the out-of-synchrony signal would differ in loudness, depending on the amount by which speakers raise their voices under DAF.
- Stuart M. Anstis worked on the adaptation to frequency-shifted auditory feedback. When the electronic frequency shift was raised gradually from zero to 300Hz.The feedback frequency shift was gradually increased on successive trials, as described that the subjects compensated for the shift and adapted to it, showing a negative aftereffect on subsequent test trials during which auditory feedback was blotted out. There subjects were merely making a conscious corrections for the feedback frequency shifts.
- Gloria J. Borden worked on an interpretation of research on feedback interruption in speech. The controversial question of the scope of sensory control in the voluntary motor patterns participating in speech is examined by reviewing studies in which the auditory, tactile, and proprioceptive feedback channels have been distorted or interrupted. The concept of internal feedback is introduced as possible control system of skilled speech, where as external feedback and response feedback are viewed as necessary for children developing speech or adults learning new speech patterns. The answer may be both constructive and regulative, constructive during the period of learning motor patterns, with component feedback (both external and response feedback) playing the major roles, and executive

after the motor patterns are well learned, with internal feedback playing the major role.

- Daniel R. Ilgen, Cynthia D. Fisher et.al explained about Consequences of Individual Feedback on Behavior in Organizations. The literature was reviewed with respect to its effect on the behavior of individuals in performance-oriented organizations. the contemporary views of individual behavior in organizations stress that feedback is necessary for effective role performance, less attention is given to the psychological processes affected by it. This analysis focuses upon the multidimensional nature of feedback as a stimulus and addresses the process by which influences behavior. Emphasis is placed on those aspects of feedback that influence (a) the way it is perceived, (b) the willingness of the recipient, and (c) agreement by the recipient to respond to the feedback.

## VI.DESIGN METHODOLOGY

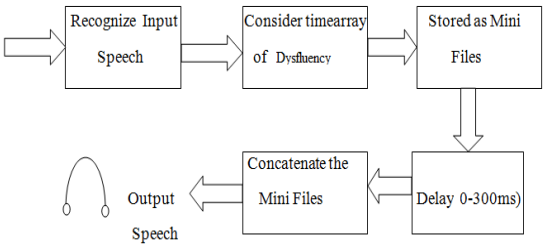



*Figure 1: Block Diagram of Delayed Auditory Feedback*

The block diagram of delayed auditory feedback is as shown in the figure1. An input speech signal is to be sampled contains energy at frequencies above the sampling Nyquist frequency. The figure2 below illustrates how aliasing would occur when the sampling rate is much too low for the frequency of a response signal. The solid bend represents the analog signal at a comparatively high frequency.

Points show where samples were taken at a relatively low sampling rate. The dotted line represents the apparent frequency of the sampled waveform, completing about two cycles in the period that the original signal completed 20 cycles. Sampling rate determines the sound frequency range corresponding to pitch which can be illustrated in the digital waveform. The range of frequencies represented in a waveform is often called its Bandwidth.

The Waveforms sampled at a high sampling rate can represent a broad range of frequencies and hence have broad bandwidth. Actually, the maximum bandwidth of a sampled waveform is determined exactly by its sampling rate. The maximum frequency represent in a sampled waveform is termed its Nyquist frequency, and is equal to one half of the sampling rate. Obviously, aliasing has the effect of generating sounds of lower frequency from sounds that are higher in frequency than the Nyquist frequency. Once aliasing has occurred, it is veritably impossible to distinguish a component generated by aliasing from one that was absolutely present in the input signal.

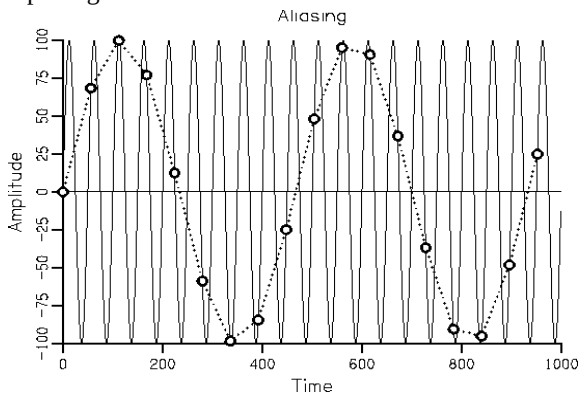



*Figure 2: Sampled input of the disorder speech signal*

The speech or the signal is given as the input to the system, the given input signal is recognized and processed. After the recognition of the input signal the time array of the dysfluency is considered. Each array is considered as separate audio file and each audio file is saved as mini files. All these files are always stored in .WAV format.

After creating the directory of mini files the delay for each mini file is provided, any delay between 0-300ms can be given to the voice signals. The delay is given through the delay array. Once the delay is given to the mini files we concatenate the file names to form a single file. After concatenating the file name we concatenate all the temporary audio files to form a single audio file, which is the final audio.

The final audio is the output speech signal. After saving the final audio we remove all the temporary audio mini files from the directory permanently. The output audio is obtained in the folder in which the input audio is stored and this output audio can be heard through headphones or loudspeakers.

ALGORITHM

The algorithm followed in delayed auditory feedback for speech disorders is as given below.

1. Selection of audio file and reading the data.
2. Storing the data into a temporary variable for editing.
3. Getting the length of total data.
4. Checking for temporary folders to create the edited audio file and concatenating the file name.
5. Calculating the delay data count.
6. Creating the delay and adding it to the audio bits.
7. Saving these audio bits in the folder.
8. Merging all the audio bit and creating the final audio file and save this into the folder.
9. Deleting the audio bits and temporary directory.
10. Plot the input and output waveforms.

FUNCTIONS USED:

1. AUDIO READ:

[Y, FS]=audioread(FILENAME) reads an audio file specified by the string FILE, returning the sampled data in Y and the sampled rate FS,in Hertz.

[Y,FS]=audioread(FILENAME,[ START END]) returns only samples START through END from each channel in the file.

[Y,FS]=audioread(FILENAME,DATATYPE )specifies the data type format of Y used to represent samples read from the file.

2. AUDIO WRITE:

audiowrite(FILENAME,Y,FS) writes data Y to an audio file specified by the filename FILENAME, with a sample rate of FS Hz.

The audiowrite writes audio data to computer's audio device such as speakers.

3. AUDIO INFO:

To get the audio information about an audio file.

INFO=audioinfo(FILENAME)returns a structure whose fields contain information about an audio file. FILENAME is a string that specifies the name of the audio file. FILENAME must be in the current directory, in a directory on the MATLAB path,or a full path to a file.

4. LENGTH OF THE FILE:

length(file); Save in variables else display in common window itslef.

5. BITS PER SAMPLE :

Number of bits per sample to write out the audio file. Only supported for WAVE( .wav)and FLAC (.flac) files. The values vary depending upon the supporting format.

6.PLOT:

lineseries = plot(h,parameter) plots the specified parameter on an X-Y plane in the default format.

7.SUBPLOT:

subplot divides the current figure into rectangular panes that are numbered rowwise. h = subplot(m,n,p) breaks the figure window into an m-by-n matrix of small axes, selects the $p^{th}$ axes object for the current plot, and returns the axes handle.

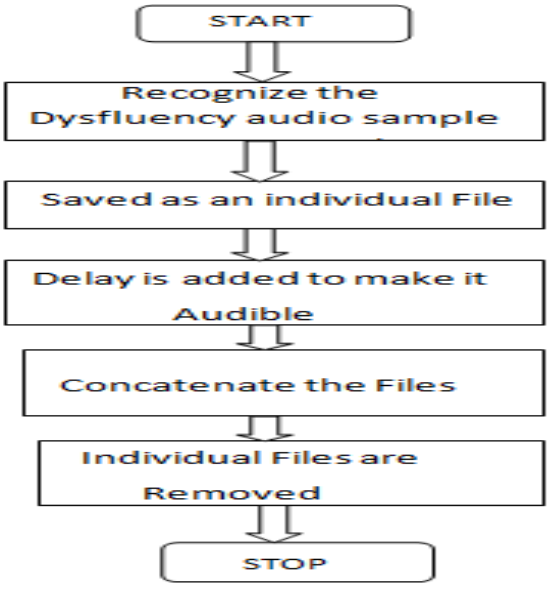
ex:subplot(2,1,1)

8.EXIST:

Check existence of variable, function or directory. It returns the status of name like if name does not exist, if name is a variable in the workspace.

Syntax: exist name
exist name kind
A = exist('name','kind')

FLOWCHART




VII.RESULTS

Step 1: Opening of the new folder in the matlab to write the code

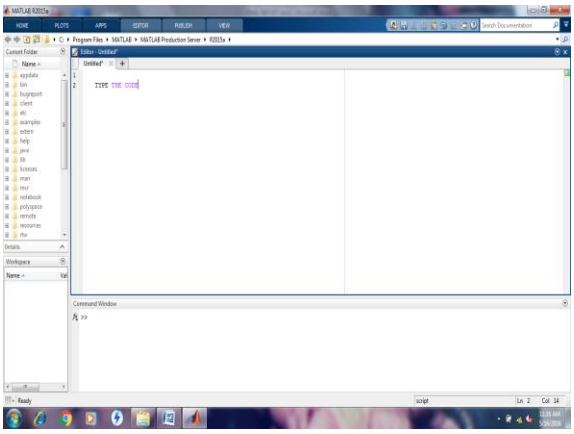


*Figure 3 : editing window for writing the code*

Step 2: Writing the code in the matlab new script.

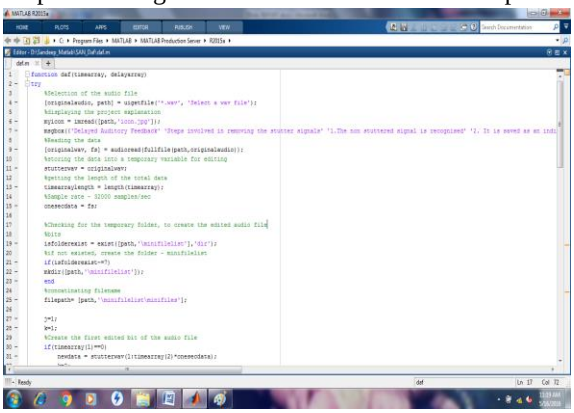


*Figure 4: Write the code to the matlab new script*

Step 3: written code in the matlab is added to the path.

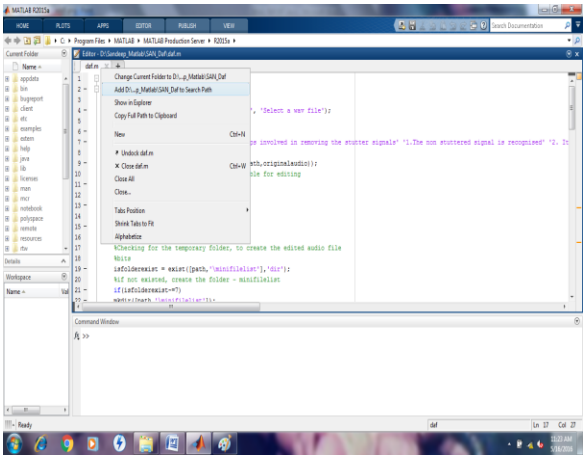


Figure 5 :Add the path to the code

Step 4: The time array and delay array is given to the function of the code to get the output. Delay array is given with the range of 0-300ms.

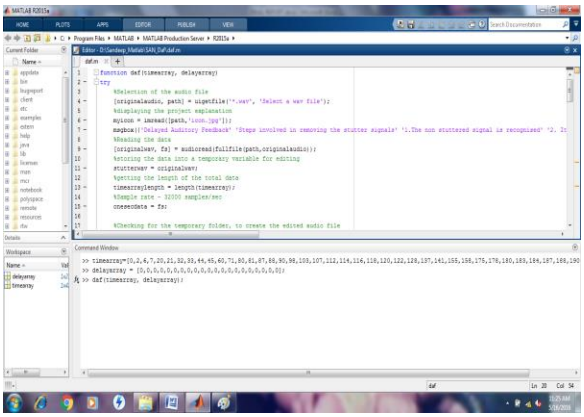


*Figure 6: Give the time array and delay array to the function of the code*

Step 5: Attach the input speech file which is stored in the drive to the code to get the output.

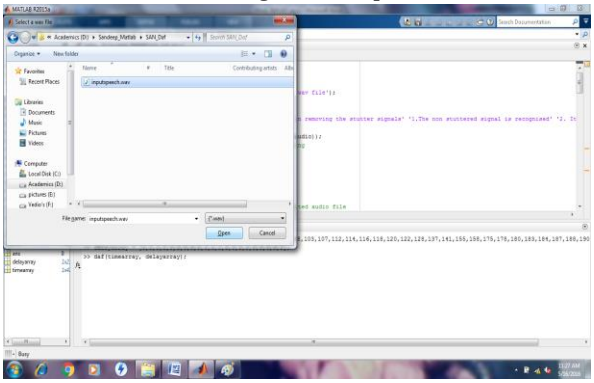


Figure 7 :Attach the input speech file to the code

Step 6: After the attachement of the input speech, the dialog box will appears which contains the information about the delayed auditory feedback.

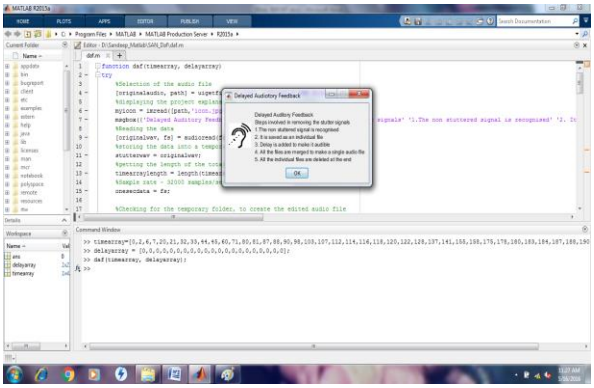


*Figure 8:Dialogbox which contains information of DAF*

Step 7: The input and output waveform plots are obtained.

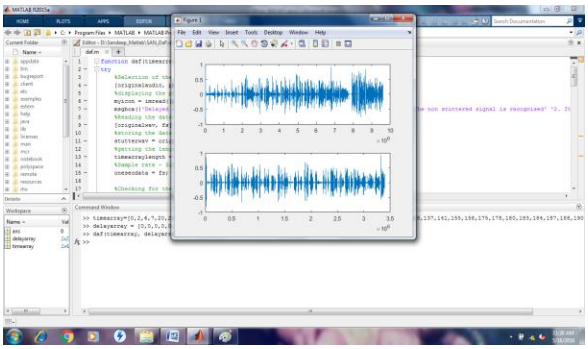


*Figure 9:Plot of input and output waveforms*

## VIII.ADVANTAGES

1. The fluency of the input speech increases.
2. The analysis of the time can be done.
3. Intelegibility will increase.

## IX. LIMITATIONS

1. This cannot be used regularly, it is for occasional use.

## X. APPLICATIONS

1. The fluency of the input speech increases which is useful for any dysfluencies.
2. The slowing of the input speech is done by inducing the fluency which is widely utilized with a diversity of disorders including aphasia, dysarthria, dyspraxia, Parkinson's disease and vocal tremor.

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## XI. CONCLUSION AND FUTURE WORK

DAF is a potentially helpful technique in the treatment of dysfluency. Several devices for DAF are also commercially available. However, not all individuals who experience a positive effect on speech fluency when speaking under DAF. And those who do show a positive effect that may differ considerably as to the degree and the conditions in which the effect is seen. Therefore, the decision whether or not to make an attempt the use of DAF in an given client is usually not straightforward.

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