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TIME SCALED MODULATED SIGNAL AND ITS VARIATION IN REAL SATURATED TIME SHIFTED COMMUNICATION STRATEGIES

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ABSTRACT

Time scaling and its modulation over saturated time shift strategies are one of the best suitable methods to develop time stretched topologies. In this paper analysis of shifted standards through which Time Scaled modulated signal can be applied in several communication strategies depending on the frequency and phase of the amplitude. It is necessary to tackle physical topology challenges and to adequately use a limited platform. We should take a simple scaled signal and generate quality and compare it with theoretical values to applaud the traditional values. The interpolation introduced in this particular topology is very helpful to demonstrate various communication standards. We have signal statistics that are unknown and varying in real-time implementations. The signal statistics associated with interpolated communication are essentially changing throughout time interval. For scaling purpose we used the available traditional communication topologies like amplitude, phase and frequency. Therefore if we try to time-stretch the signal by making it faster, we do not have the ability to grab the future frames which makes speeding up the signal impossible. However in order to slow down the signal we are simply, in some cases, repeating parts of the known signal, therefore time-stretching used to decrease the speed of signal. Also as per application point of view this analysis helps to understand interpolated shifting behavior towards communication topologies.

KEYWORDS: *Time Scaling; Communication; Stretching; Interpolation; TRNS; SOLA; ZCR*

Article History

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INTRODUCTION

We categorized the basic signal operations into two types depending on whether they operated on dependent or independent variables representing the signals. Addition, subtraction, multiplication, differentiation, and integration fall under the category of basic signal operations acting on the dependent variable. Now we concentrate on the basic signal operations which manipulate the signal characteristics by acting on the independent variable(s) which are used to represent them. This means that instead of performing operations like addition, subtraction, and multiplication between signals, we will perform them on the independent variable. In our case, this variable is time (t). [1-3]

Another field that involves the concept of time delay is artificial intelligence, such as in systems that use Networks. In Time Scaling; till now we understand more about performing addition and subtraction on the independent variable representing the signal, we'll move on to multiplication. For this, let's consider our input signal to be a continuous-time signal x (t) as shown by the red curve in Figure1.Now supposes that we multiply the independent variable (t) by a number greater than one. That is, let's make t in the signal into, say, 2t. The resultant signal will be the one shown by the blue curve in Figure 1.From the figure, it's clear that the time-scaled signal is contracted with respect to the original one. [4-8]

Figure 2 shows to find out phenomenon about it we start analyzing details sequentially. In this time-scaled signal indicated by the green dotted-line arrows. Although we have analyzed the time-scaling operation with respect to a continuous-time signal, this information applies to discrete-time signals as well. However, in the case of discrete-time signals, time-scaling operations are manifested in the form of decimation and interpolation. Basically, when we perform time scaling, we change the rate at which the signal is sampled. Changing the sampling rate of a signal is employed in the field of speech processing. A particular example of this would be a time-scaling-algorithm-based system developed to read text to the visually impaired. Next, the technique of interpolation is used in Geodesic applications (PDF). This is because, in most of these applications, one will be required to find out or predict an unknown parameter from a limited amount of available data. In Time Reversal we have assumed our independent variable representing the signal to be positive. It can be negative. As a result, the operation is applying known as the time reversal or time reflection of the signal. [9-10].

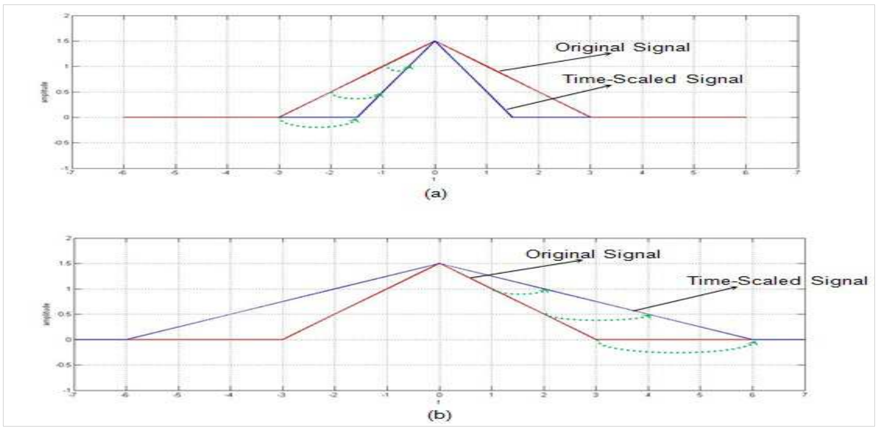

Figure 1: Original Signal with Its Time-Scaled Versions.

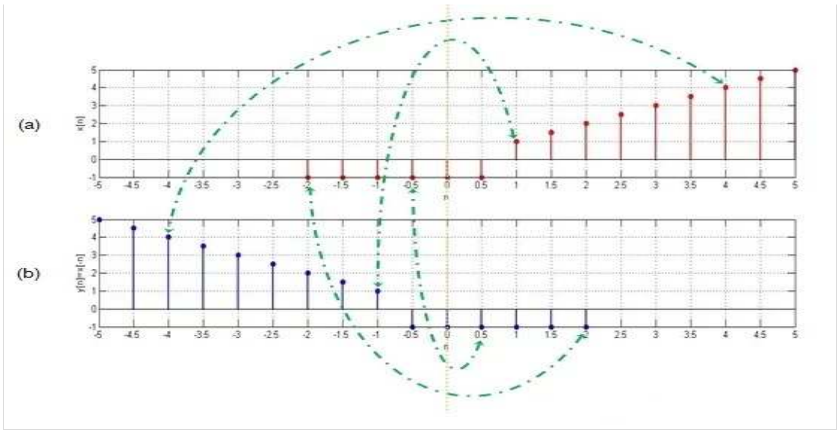

Figure 2: A Signal with its Reflection in Time Scaled Domain.

Theoretical Considerations

Time scaling or Time stretching is the process of slowing down or speeding up an audio signal without changing the pitch.(Figure3).The applications of time-scaling are numerous with an example given above as well as reading text for the blind, and learning a foreign language. Time scaling is performed by dividing the signal into fixed overlapping frames.

These overlapping frames are then shifted according to the overall goal (speeding up or slowing down) and combined to give a reconstructed output. The algorithm will at first be simply implemented using basic techniques with each assignment adding an increased difficulty. Toward the end of the class this algorithm will be implemented in real time.

Synchronous Overlap and Add synthesis is very similar to that of the general OLA procedure that was presented previously. The main difference between the two is that SOLA relies on correlation techniques to improve on the time-stretching algorithm. When the blocks are shifted by the time factor α similarities in the area of the overlap intervals are searched for a discrete-time lag of maximum similarity. These points of maximum similarity of the overlapping blocks are then weighted by a fade-in fade-out function and again summed sample-by-sample. (Figure 4)

Time reversal is an important preliminary step when computing the convolution of signals: one signal is kept in its original state while the other is mirror-image and slid along the former signal to obtain the result. Time-reversal operations, therefore, are useful in various image-processing procedures, such as edge detection. A time-reversal technique in the form of the time reverse numerical simulation (TRNS) method can be effectively used to determine defects. For example, the TRNS method aids in finding out the exact position of a notch which is a part of the structure along which a guided wave propagates. [10]

If the broadcasts are recorded and played back for a listener, a simple remedy for this quick pace is to simply slow down the playback of the audio. The cross-correlation is a way to determine the similarities of two waveforms over a time-lag. It is used extensively in signal processing to find smaller wave forms in a longer sample which leads to pattern recognition. We will use this cross-correlation information in order to find the place with maximum similarity between the overlap intervals of the time shifted signal. The cross-correlation is found by

$$Rx_{L1}*Rx_{L2}= 1/L \sum x_{L1} (n)*x_{L2} (n+m) ; 0<n<L$$

Where xL1 (n) and xL2 (n) are the segments of x1(n) and x2(n) in the overlap interval of length L.

Using the zero-crossing rate is rudimentary pitch detection algorithm. It works well in the absence of noise and is discussed here for its simplicity and computation. We define a function sign < > that returns a +1 or 0 depending upon whether the signal is greater than zero or not. The zero-crossing rate (ZCR) may then be given as

$$ZCR=1/N\sum \text{mod}[\text{sign}<s(n)>-\text{sign}<s(n-1)>];0<n<N-1$$

Where the 1/N provides the normalization to find the crossing rate. In order to calculate the fundamental frequency f’ of the waveform in the frame we use the following formula

$$f'=ZCR*f_s/2$$

The ZCR approach works well for pure speech tones as well as some speech segments. Therefore we can modify the zero-crossing rate with the use of a threshold. A threshold is proposed in the form of

$$® = \mu . 1/N\sum \text{mod}[s(n)]; 0<n<N-1$$

Where μ is about 1.2.Now we define

$$s_p = s(n)- ®$$

Instead of counting the ZCR we count only the negative to positive transitions (ZCRp). This gives a positive rate transition which corresponds to a half-period fundamental frequency of

$f'_p = ZCR_p * f_s$

Likewise a negative displacement to the ZCR is given as

$S_n = s(n) +$ ®

Similarly, to the positive displacement only the positive to negative transitions are counted resulting in another half-period fundamental frequency of f_n. Finally the true fundamental frequency is given as the mean of the two frequencies

F= (fp+fn)/2

In the presence of noise these techniques become even more difficult as there is often severe jitter around the zero crossing point. Another concept of a threshold-crossing rate (TCR) can therefore be introduced that takes into account the amount of noise that is present in the system. [11-14]

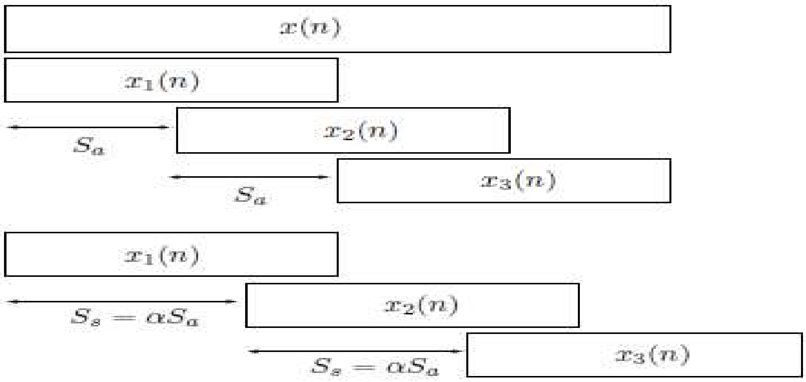

Figure 3: Time Stretching or Scaling.

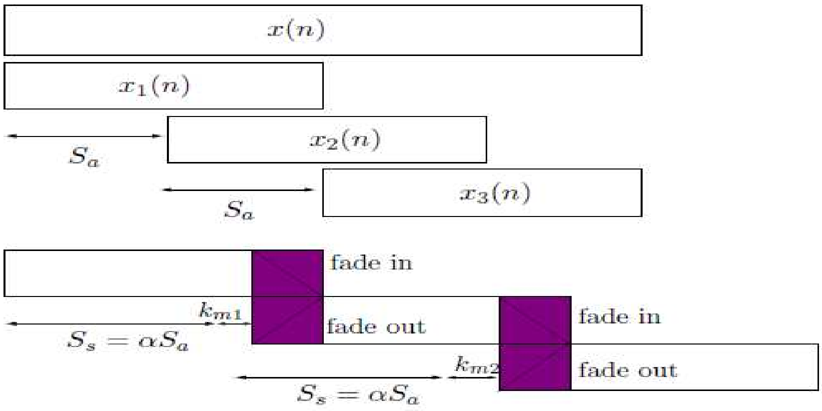

Figure 4: Time Stretching: Synchronous Overlap and Add (Sola).

RESULTS

While we will not focus on sample rate conversion it is important to understand the overall effect on the frequency information when a signal is stretched in the time domain. We now use the index that corresponds to the maximum correlation as a way to overlap the signals. (Figure 5 & 6)

In Figure 5 the original and its time delayed version are shown. We analyzes from above that there is the presence of lag between original signal and its time delayed variant. This creates a phenomenon that time interpolated variant signal exhibits lag as compared to original signal. To analyze it properly we should introduce another factor of communication topologies such as cross correlation, PSOLA, zero crossing structures. The cross correlation exhibits their properties when we use transform platforms like Fourier, Laplace etc. Here we use Fourier as a tool for this purpose.

If we want to see the related spectrum of cross correlated signal rather than original signal then we see from plot as shown by Figure 6 at maximum correlation point there will be offset value to introduce the exact relationship between cross correlated value and original signal value.

Pitch-synchronous Overlap Add uses the hypothesis that the input sound is characterized by a pitch. It exploits the knowledge of the pitch to correctly synchronize time segments avoiding pitch discontinuities. The PSOLA algorithm is essentially divided into two steps: the first phase analyzes the segments of input sound and extracts the pitch information. (Figure 7).The second is utilization of information associated with original signal. The PSOLA is a important mechanism to understand learning of signal variation in time stretching communication strategies in real saturated interpolated signaling pattern and due to PSOLA we understand the corresponding pitch algorithm, its variation, interpolation and overlapping structural mechanism with other possible patterns. The time delaying pattern and PSOLA pattern creates a wonderful behavior of signal in saturated signaling schemes. MATLAB gives the exact plots and as well as demonstrates numerical value of it. The pitch length gives us wavelength of time delayed signal and original signal. Here interpolation makes a vital role for the movement of wave in communication systems. If we use its variation corresponding to frequency, phase and amplitude and applied the individual interpolation mechanism then we see the structure is very well and easy to understand for the same.

Pitch is an attribute that is associated with the frequency of a sound. Depending on the frequency of the signal it is classified to a certain pitch. While the two are not equivalent the usage of pitch information will play a critical role in time stretching. The zero-crossing rate determines how many times the waveform crosses the zero-axis in a certain time. Figure 8 shows a 100 Hz sine wave on a measurement interval at 20ms. There are 4 zero-crossing throughout the sample frame.

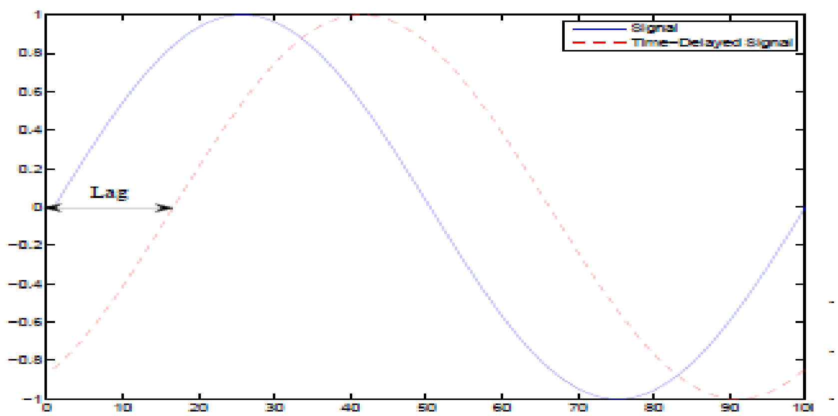

Figure 5: Original Signal and Its Time Delayed Version.

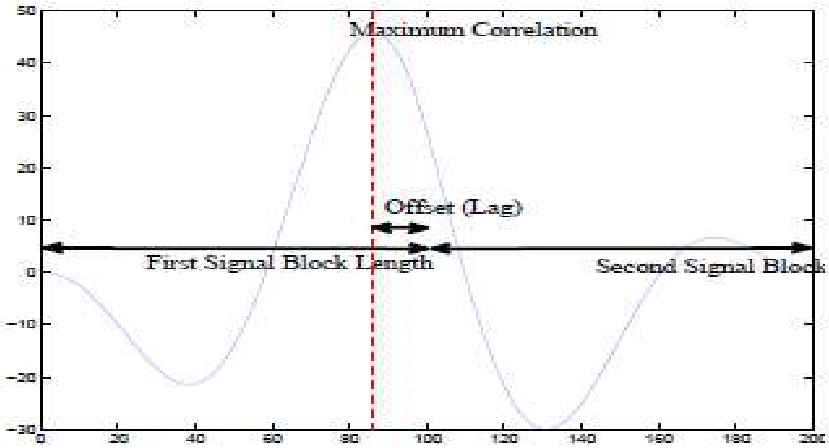

Figure 6: Cross Correlation between Original Signal and Time Delayed Version of Itself.

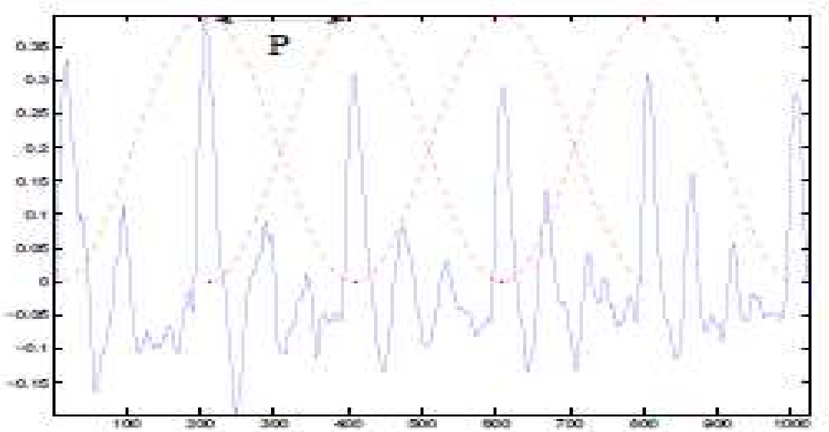

Figure 7 PSOLA: Pitch Analysis and Block Window.

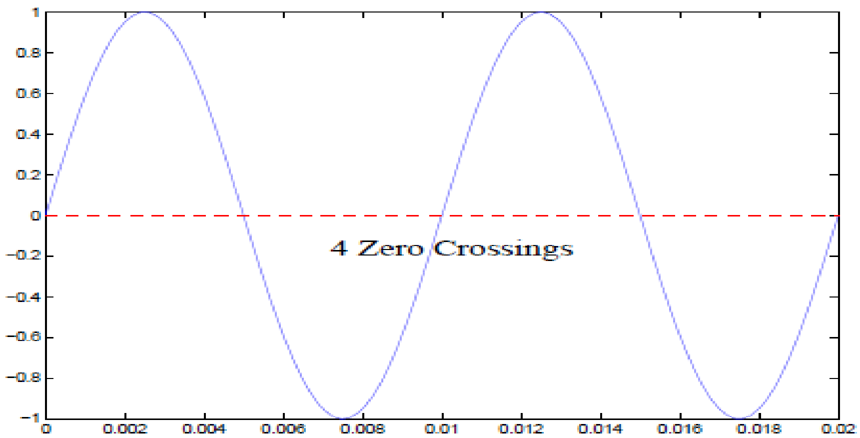

Figure 8: Zero Crossing for a fs= 100Hz.

CONCLUSIONS

For the previous implementations of the time-stretching algorithms we have used recorded signals where the statistics have been known during the whole processing period. In real-time implementations we have signal statistics that are unknown and changing throughout time. Therefore if we try to time-stretch the signal by making it faster, we do not have the ability to grab the future frames which makes speeding up the signal impossible. However in order to slow down the signal we are simply, in some cases, repeating parts of the known signal, therefore time-stretching used to decrease the speed of the speaker is possible. MATLAB comes with the availability to do real-time implementations by way of the built in package simulink. Use the simulink package in order to implement your time-stretching algorithm in real-time. After we have a working time-stretching algorithm in the simulink environment we will merge this with the other groups. Therefore it is recommended that before the initial design process in simulink the two groups discuss with each other what input and output parameters the other group needs in order to construct a working model. It was determined that there is a direct correlation between the SNR and link quality associated with a given link between nodes. The information could be easily obtained from network management software tools.

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