International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Determination of Good and Bad Signal in a Given Random Signals Using MATLAB

Charles Okanda Nyatega[1], Ogunlade Michael Adegoke[2]

[1]Department of Electronics Engineering, Tianjin University of Technology and Education, Tianjin, China

[2]Department of Electronics Engineering, Tianjin University of Technology and Education, Tianjin, China

Abstract: ***In this modern world we are surrounded by all kinds of signals in various forms. Some of the signals are natural, but most of the signals are manmade. Some signals are necessary (speech), some are pleasant (music), while many are unwanted or unnecessary in a given situation. Therefore extracting or enhancing the useful information from a mix of conflicting information is the simplest form of signal processing [1]. Signal processing is so wide and very interesting in solving many engineering problems, in this paper we used it in bad and good signal detection where by the different samples of signals (sound wave) were provided and from there to select the good ones or bad ones using MATLAB software with the help of Fast Fourier Transform (FFT). Signal analysis procedures have been followed to get the required results by comparing the good known signal s1 and the rest of unknown random signals s2 and s3. Most parameters used in comparison are cross correlation factor and the magnitude of the given signal samples. In the final part we will be able to see the resulting waves using MATLAB showing both magnitude and cross correlation.***

Keywords: MATLAB, Signal, Correlation, Magnitude, FFT

1. Introduction

The aim is to detect the bad and good signals from the given random signals, which in turn help in correcting the malfunctioned gears hence points to the direct use of signal spectrum analysis in which we are going to use time domain signal analysis to analyze the spectrum patterns of signal under investigation.

In analyzing the spectrum patterns we set one good sound wave as reference and from there we compare the rest of the signals, we mainly use two methodologies that are the cross correlation property and the magnitude comparisons of the two signals so that the variation of the values of each property determines how far the measured signal deviates from the reference signal and to be labeled as good or bad signal. For the successful implementation, we used MATLAB software for simulation and coding of the project.

Using different types of the given sound samples we were able to run the project and obtained the required results and the output graphs that can be used in the whole process of explaining the procedures of selection of good and bad sound from the gears. Hence with this project is easy to spot out and make amends to the gears in the production process.

2. Correlation between the wave forms

The correlation between the waveforms is a measure of the similarity or the relatedness between the waveforms[2]. To understand the correlation between two waveforms, let us start by multiplying these waveforms together at each instant in time and adding up all the products. If, as in *Figure 1*, the waveforms are identical, every product is positive and the resulting sum is large. If however, as in *Figure 2*, the two records are dissimilar, then some of the products would be positive and some would be negative. There would be a tendency for the products to cancel, so the final sum would be smaller.

Figure 1: Correlation of two identical signals

Figure 2: Correlation of two different signals

Now consider the waveform in *Figure 3a*, and the same waveform shifted in time, *Figure 3b*. If the time shift were zero, then we would have the same conditions as before, that is, the waveforms would be in phase and the final sum of the products would be large. If the time shift between the two waveforms is made large however, the waveforms appear dissimilar and the final sum is small

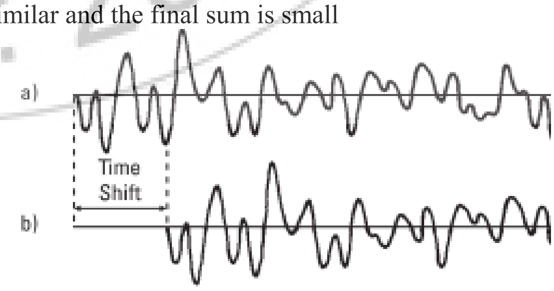

Figure 3a, 3b: Correlation of time displaced signals

2.1 Cross correlation and Auto Correlations

Correlation determines the degree of similarity between two signals. If the signals are identical, then the correlation coefficient is 1; if they are totally different, the correlation coefficient is 0, and if they are identical except that the phase is shifted by exactly 180^{0} (i.e. mirrored), then the correlation coefficient is -1.

When two independent signals are compared, the procedure is known as *cross-correlation*, and when the same signal is compared to phase shifted copies of it, the procedure is known as *autocorrelation* [3]. Cross-correlation is the method which basically underlies implementations of the Fourier transformation: signals of varying frequency and phase are correlated with the input signal, and the degree of correlation in terms of frequency and phase represents the frequency and phase spectrums of the input signal.

All in all cross correlation is a measure of similarity between two signals, while autocorrelation is a measure of how similar a signal is to itself [4] In the next chapter we are going to make the use of cross correlation during the implementation.

3. Implementations and Results

In this part we have three signals to test in which the reference good signal ***s1*** is known and we are going to compare it with other two unknown signals ***s2*** and ***s3***. Observe the following output with the values indicated as well as the magnitude of the plotted graphs.

3.1 Comparing the same signal s1-s1

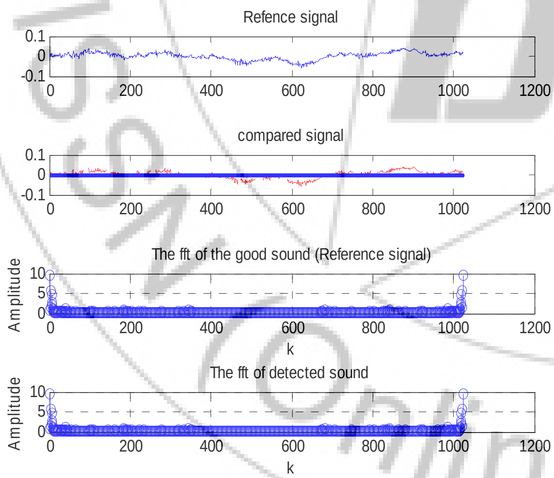

Figure 4: s1-s1

MATLAB results;
s1-s1 (same signals compared)
Project: Bad/Good signal detection
Enter a signal vector: s1
factor = 1.0000
OUTPUT: Good signal No.1 is detected,
The magnitude is 0.000000 smaller than the threshold value.

3.2 Comparing signal s1 and unknown signal s2

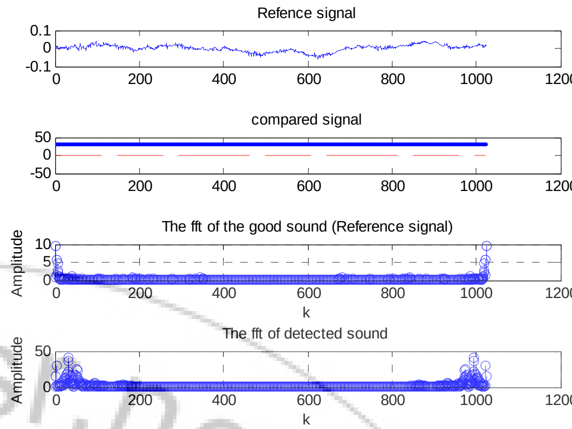

Figure 5: s1-s2

MATLAB results;
s1-s2 (signal s1 and signal s2 compared)
Project: Bad/Good signal detection
Enter a signal vector: s2
factor = 0.2380
OUTPUT: Bad signal No.2 is detected,
The magnitude is 31.376887 smaller than the threshold value.

3.3 Comparing signal s1 and unknown signal s3

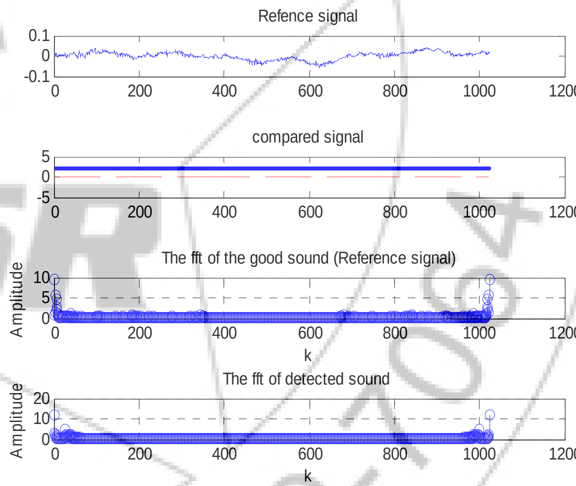

Figure 6: s1-s3

MATLAB results;
s1-s3 (signal s1 and signal s3 compared)
Project: Bad/Good signal detection
Enter a signal vector: s3
factor = 0.6304
OUTPUT: Bad signal No.3 is detected,
The magnitude is 2.136491 smaller than the threshold value.

Let's have a look at the following table for better observations;

Table 1: Correlation Vs magnitude

Signal number	*Correlation factor*	*Difference in magnitude from s1*
S1	1.0000	0.0000
S3	0.6304	2.1365
S2	0.2380	31.3769

Figure 6: Table of results

4. Conclusion

From the above results as shown in the figures from the practical observation, we learnt that the signal with the highest correlation factor almost or equal to 1or the signal with the lower difference in magnitude to the reference signal is regarded as the best signal or signal almost equal to the reference signal on the other hand, the signal with lowest correlation factor and highest different in magnitude can be regarded as bad signal.

In this entire project, the central theme is the generous use and adequate demonstration of MATLAB, which can be used as an effective teaching as well as learning tool. Most of the existing MATLAB functions for Digital Signal Processing are described in detail, and their correct use is demonstrated in many examples [5], to which it helps us to fully implement this project.

Our research was based on only two parameters which are cross correlation factor and the magnitude of the given signal samples, which limited us to know other ways of solving the problem, for the future researchers we would advise them to try other means of solving it hence to get better results.

References

[1] Vinay K. Ingle, John G. Proakis, "Digital Signal processing using MATLAB" 3rd Edition, pp2.
[2] Rao B. Visvesvara, Rajeshwari & Rao,"Signals and Systems" pp 123.
[3] Dafydd Gibbon, "Correlation", Wed May 22 08:36:40 MET DST 1996.
[4] Jonathan Y. Stein, " Digital Signal Processing: A Computer Science Perspective"
[5] Vinay K. Ingle, John G. Proakis, "Digital Signal processing using MATLAB" 3rd Edition, pp21.

Authors Profile

Charles Okanda Nyatega, born in Shirati, Rorya District, Mara Region, Tanzania. He received the B.E. degree in Telecommunication Engineering from Huazhong University of Science and Technology in 2010, He received M.Eng in Signal and Information Processing Engineering at Tianjin University of Technology and Education, P.R.China., while working as Assistant Lecturer at Mbeya University of Science and Technology, Mbeya, Tanzania.. His research interests include Telecommunications; Signal processing, Antenna Design, Embedded System and Wireless Communication.

Ogunlade Michael Adegoke was born in Ekiti State Nigeria. He received his M.Eng Degree in the Department of Electronics Engineering, Tianjin University of Technology and Education, China. Also, B.Eng [Honor] from the University of Ado Ekiti, Nigeria, and Higher National Diploma in Electrical & Electronics Engineering from The Federal Polytechnic Ado Ekiti, Nigeria. Academic scholarship awards received includes: Ekiti State Government scholarship Nigeria, CSC Scholarship China, EKPANY Scholarship New York U.S.A. He is a Member of IEEE. Work with Ekiti State Government, Nigeria. His major research interest includes; Antenna Design, wireless Communication and embedded system Design.