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Facet Analysis and Designing of Fault Sound and Background Noise of Large Central Air Conditioner

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Abstract: Execution of time postpone estimation (TDE) calculation straightforwardly influences impact of electromechanical gear blame sound source situating in light of TDE. Planning more exact calculation based appropriate models of foundation clamor and blame sound can enhance precision of restriction. Right off the bat, this paper examines the qualities of clamor and blame sound of outer focal aeration and cooling systems, at that point, models ecological commotion utilizing Alpha dissemination. At last, Analyzes estimated information and preprocess them, understand the more suitable displaying of natural commotion and take out working clamor sources obstruction. This examination has a directing importance in extensive scale mechanical and electrical gear disappointment sound source flag displaying, and is useful to inquire about on TDE calculation.

Keywords: Electrical and Mechanical Equipment, Sound Source Positioning, TDE, Fault Sound Analysis, Noise Analysis and Process.

1. INTRODUCTION

Mechanical and electrical equipment accuse sound source restriction in light of TDE can choose Fault region, by then posing answers for fault, which means to avoid fault to develop, decrease peril of disasters and reducing upkeep costs. For instance, generator acoustic accuse recognizable proof, [1] wind turbines source arranging, [2] control station pot spillage source arranging. [3] Sound source arranging is in two stages to complete, TDE and geometric arranging. Execution of TDE specifically influences arranging sway. Genuine accuse sound banner assembled reliably contains establishment noise, It is a total of various sounds in the midst of undertaking clearing issue sound banner. Showing establishment uproar and accuse sound correct model, by then, arranging sensible TDE figuring can upgrade exactness of TDE as demonstrated by these banner models.

Gaussian scattering is used to show uproar in various source constraint in light of TDE, [4] that accords with the method of bustle age, point of convergence of repression theory can exhibit its sensibility. Nevertheless, there are non-Gaussian hullabaloo with hurried banners in the bona fide state of mechanical and electrical equipment, for instance, low-repeat ecological disturbance, [5] mechanical and electrical apparatus assignment racket and man-made uproar. [6] Gaussian-based bustle isn't fitting for depicting commotion with hasty banner, it causes execution debasement of TDE Algorithm in light of Gaussian supposition. Racket model can be approximated to a Gaussian allocation by blanking drive bustle suggests, [7] however other count ought to be planned to get blanking fuss edge, it can impact hail characteristics in non-Gaussian confusion with more hurried signs.

This paper takes a gander at blame sound and working aggravation for focal circling air through and cooling machine, and hypothetically inquires about electromechanical hardware organic clack, utilizes Alpha stream demonstrate adjust including clamor and offers techniques to pick turmoil show parameters. By at that point, get focal ventilate clamor in task , isolate hullabaloo attributes in the time an area and rehash space, and preprocess utilizing relating rehash step channel.

2. FAULT SOUND AND BACKGROUND NOISE ANALYSIS AND DESIGNIMG

2.1 Fault Sound Analysis

Air dissemination and cooling structure outside machine noise mainly includes:[8] odd racket caused by unmatched fan and air channel, AC clamor made by engine task, low rehash tumult caused by stunning pipeline outline and

amazing change caused by uncalled for increase together process control, The hubbub conveyed by the machine reverberation. Ref. [9] showed 2.38 kHz blame cry in the entry divide for the refrigerant pipe.

Electromechanical hardware denounce sound pennant and voice hail, at the present time vitality sound standard is totally different. Voice flag is non-stationary, time-changing; right away criticalness sound pennants, for example, weapon sound, broken glass sound is brief time, transient centrality; and mechanical and electrical hardware blame sound standard and foundation racket has a predictable, settled charge sound rehash band characteristics, low flag to clamor ratio(SNR), and foundation commotion is mind boggling. They utilize same system to find sound source, however hail dealing with strategies are overall unprecedented among them.

2.2 Background Noise Analysis

Establishment clatter is a total of various sounds in the midst of movement emptying issue sound banner, it is secluded into operational upheaval and natural noise for examination and showing.

2.2.1. Working Noise Analysis

Ventilating running confusion are basically include: [8]fan undertaking wind stream sound, compressor movement clatter, refrigerant stream sound, pipeline vibration uproar, cooling heat exchanger system errand commotion. Clatter delivered by fan is in the region of 500 and 800 Hz, confusion made by compressor is in the region of 1 and 2 kHz, fuss of structure is around 100 Hz, and low repeat disturbance is around 20-60 Hz.

Operational clatter can be cleared by overlay strategy, [10] however a couple of portions can't use it. It can be wiped out in the repeat zone through range examination, illustrating suitable parameter step channel or band-end channel to get whatever remains of the band commotion data, by then, signal getting ready, discovering lack sound source. In case accuse signal spreads with the repeat scope of average repeat band, hoping to use distinctive methods to channel the working clatter.

2.2.2. Ecological Noise Analysis

Condition noise of ventilation framework is non-Gaussian uproar containing implusive banner, it may start from Atmospheric discharge;[11] Medium and high repeat electrical equipment trading process; mechanically worked and transmitted;[12] some phony fuss; Signal acquirement and change process.

2.3 Alpha Stable Distribution

Alpha stable dispersion is a summed up Gaussian model. As indicated by the summed up focal farthest point hypothesis, [13] it is as far as possible circulation that structures the entirety of autonomous and indistinguishably disseminated arbitrary factors, and Gaussian appropriation is a subclass. The distinction between Gaussian conveyance and Alpha appropriation is that Gaussian dissemination has an exponential trailing and Alpha circulation has a mathematical trailing. In this way, Alpha circulation better depicts beat process in commotion.

There is no logical articulation for the likelihood thickness capacity of Alpha's steady dissemination with the exception of just a couple. The eigenfunction and the likelihood thickness work are the main deterministic relations with each other. The eigenfunction is basically the opposite Fourier change of the likelihood thickness work. Them two can totally portray the factual attributes of an arbitrary appropriation. The accompanying is the presentation of the eigenfunction of the Alpha enduring state conveyance.

In the event that irregular variable has parameters $0< \alpha \leq 2$, $\gamma \geq 0$, $-1 \leq \beta \leq 1$, and the genuine number α, the eigenfunction has the accompanying articulation:

$$\emptyset(t) = \exp\{j\alpha t - \gamma|t|^{\alpha}[1 + j\beta sgn(t)\omega(t,\alpha)]\} \quad (1)$$

$$\omega(t,\alpha) = \begin{cases} \tan\frac{\alpha\pi}{2}, & \alpha \neq 1 \\ \frac{2}{\pi}\log|t|, & \alpha = 1 \end{cases} \quad (2)$$

$$sgn(t) = \begin{cases} 1, & t > 0 \\ 0, & t = 0 \\ -1, & t < 0 \end{cases} \quad (3)$$

The irregular variable X obeys α stable dissemination. Parameter α is trademark record in equation (1), it decides beat level of α stable dissemination. The littler α esteem is, the thicker following conveyance is, and the more incautious example is. Despite what might be expected, the α esteem winds up bigger and the following of appropriation ends up more slender and the hastiness of test debilitates. At the point when $\alpha = 2$, the α appropriation relates to Gaussian dissemination, and the α unfaltering distributionβ is summed up Gaussian distributionγ.

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Parameter decides the slant of dispersion, is the scattering coefficient, which is a measure of the level of scattering in respect to the mean, and α is the middle or mean of alpha dispersion. These parameters in the eigenfunction are resolved from estimated tests as indicated by the techniques in [14], [15] and [16].

In commotion displaying research, PC needs to create alpha unfaltering state circulation test. Chambers, Mallows and Stuck et al. proposed an exact and down to earth test age strategy. The essential thought is to make a progression of free non-uniform circulation arbitrary factors Linear change into a steady conveyance of irregular factors. [17]

2.4. SNR

SNR is likewise one of the principle flag qualities in flag displaying process. There is no change in Alpha stable dissemination, which can't be estimated by traditional power definition, and can be estimated by the scattering coefficient γ,[18] utilizing blended SNR rather, SNR=10log σ& is difference of acoustic flag. In count of real ecological power, power can be communicated by taking the difference of the example. Keeping in mind the end goal to acquire electromechanical gear foundation condition control, utilizing pertinent estimating instruments, for example, sound level meters decided the SNR inside a particular range. [19] flag examining prerequisite and dispose of associating of range. Utilize wavrecord in MATLAB to begin sound gathering, gather foundation commotion when aeration and cooling system is working regularly, record 480000 point, 16-bit determination exhibit.

3. MEASURED DATA ANALYSIS AND PREPROCESS

3.1. Background Noise Acquisition and Analysis

Select focal ventilating unit in work of Shanghai Dianji University Lingang Campus Gymnasium as the mechanical and electrical hardware foundation clamor accumulation question, commotion gathering condition as show in Figure 1. As indicated by [20], select 48 kHz examining recurrence as per the recurrence reaction scope of stationary amplifier, it can meet the most astounding recurrence.

Figure 1. Central air conditioning environment

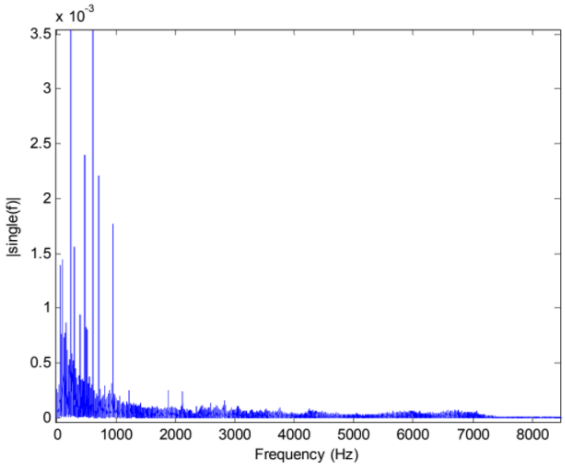

Figure 2. Frequency spectrum after process

As indicated by discrete flag Fourier extension highlights, expecting to low-pass flag separating. A 4-arrange, low-pass channel with a standardized cut-off recurrence of 0.95 is planned. [21] Figure 2 indicates recurrence range after process. Contrasted and commotion range of cooling running in [7], it can be judged that the band with substantial plentifulness in the range is the gear running clamor band.

3.2 Running Noise Segmentation Processing and Filtering

Gear working clamor produced by various standards, so loud band is extraordinary. As can be seen from Figure 2, the range of foundation clamor is thought underneath 1000Hz, and range over 1000Hz is level. As per the above

examination band stop sift is utilized to channel through bigger recurrence segments expecting to wipe out the activity commotion. Be that as it may, it is hard to configuration low-band indent channels (band-stop channels) at high examining rates. Because of low-recurrence groups may likewise have blame sound sources, so it can not totally channel low recurrence band despite the fact that contain more clamor signals. Utilize recurrence division examination in the recurrence space: Firstly, receiving a cut-off recurrence of 1000Hz low-pass channel process motion, there is no unearthly associating after handled flag, at that point flag is down inspected to 3000 Hz. At long last, planning comparing recurrence step channel or band-pass sift expect to channel through some the bigger plentifulness band commotion, the rest of the band sound can accomplish blame source situating. Step channel configuration isn't totally perfect, encompassing band will have constriction twisting, TDE calculation depends on the connection between's signs, albeit a few groups have weakening, Robustness TDE calculation can enhance precision of gauge. Essentially, asimilar recurrence area preprocess over 1500Hz.

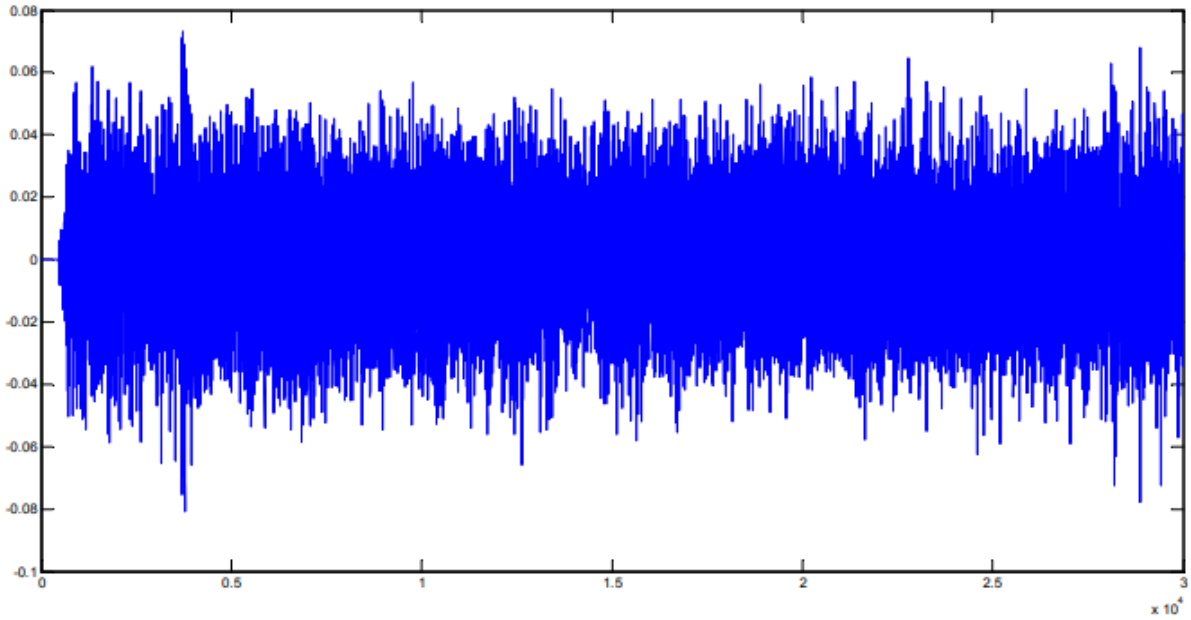

Figure 3. Time-domain waveform after process

As appeared in Figure 3 is the flag through the cut-off recurrence of 0.06 12-arrange low-pass channel and down-examining time-space waveform, The flag can at present screen the presence of fan commotion in the wake of handling.

There are abundancy recurrence outline and power chart beneath recurrence of 1500Hz of the flag in Figure 4 (an) and (b), bigger adequacy or power band in them are the recurrence band of ventilation system running commotion. Utilizing Butterworth band-stop channel wipe out the effect of running clamor on blame sound source limitation. Channel configuration depends on the relating parameters of range. Parameters, for example, Table 1, examining recurrence is 3000Hz, standardized recurrence.

As per channel parameters, outlining diverse frequencies band-stop channel in arrangement channel the flag and ascertain plentifulness and power maps, as appeared in Figure 8 (c)and(d), at that point, looking at the four pictures. Tune in to the first flag and handled flag for examination, in the wake of preparing signal pivot commotion disposal.

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Table 1. Filter (notch) parameters

Band stop filter range	Pass band upper and lower limits		Stop band upper and lower limits		Passband maximum attenuation(dB)	Stopband minimum attenuation(dB)	Filter order
62.25Hz notch	0.040	0.043	0.041	0.042	0.1	15	4
99.98Hz notch	0.065	0.068	0.066	0.067	0.1	15	4
230Hz-240Hz	0.15	0.163	0.153	0.16	0.2	10	5
399.8Hz notch	0.198	0.201	0.199	0.200	0.1	30	5
399.7Hz notch	0.265	0.268	0.2663	0.267	0.1	40	5
465Hz-471Hz	0.309	0.316	0.310	0.314	0.2	8	6
499.7Hz notch	0.332	0.335	0.333	0.334	0.1	30	5
510Hz notch	0.339	0.342	0.34	0.341	0.1	30	5
607Hz-612Hz	0.404	0.41	0.405	0.408	0.2	10	6
705Hz-711Hz	0.467	0.476	0.470	0.474	0.4	20	6
936Hz-942Hz	0.622	0.629	0.624	0.628	0.4	10	6

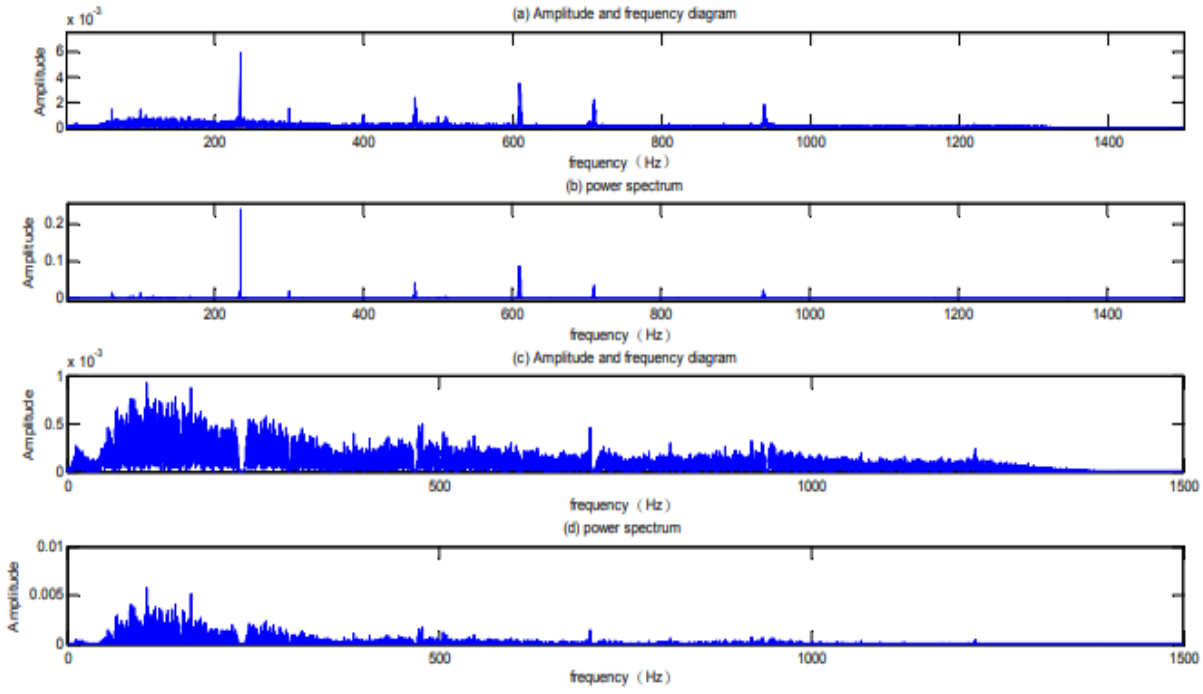

Figure 4. Filter processing amplitude and power chart comparison

3.3. Fault Sound SNR

The sound level meter can quantify space condition SNR. Its SNR is figured by duplicating base 10 logarithm of proportion of sound energy to reference sound power. On account of commotion source isn't clear or wiping out working clamor by covering, cell phone programming measure condition SNR amid ventilation system activity and decide it inside a specific range, at that point, reenacting shortcoming sound source in a superior stifled condition. Gotten two SNR can get the blame flag SNR through comparing figuring, it additionally counterbalances

reference control. The sound level meter recreates the sound-related feeling of the human ear, with a weighted system, is a subjective estimation instrument, yet in addition gives a premise to the estimation of SNR. Noticeable all around conditioner ordinary work, the product estimated condition SNR around 60dB. (Running clamor source is feebly recognizable).

4. CONCLUSION

Dissect electrical gear foundation clamor, dispose of the impact of running commotion, this can accomplish find the blame sound source in a particular recurrence band; In the outline of advanced band-stop channel, the parameter choice alludes to the current channel parameter setting, which can sift through the objective band clamor. By changing the parameters, a superior computerized channel can be outlined;

Utilizing α dispersion to show condition commotion, it can recreate surrounding clamor with various heartbeat powers concurring circumstance, which can display the encompassing commotion all the more precisely; nature SNR is incredible significance to exact demonstrating deficiency sound source flags and enhance of TDE calculation.

REFERENCES

[1] A. F. Browne, S. Patel, S. A. Kaoti, S. M. Lopez and P. Parikh, Area acoustic and electromagnetic emissions monitoring of 3-phase motors, 2017 IEEE International Electric Machines and Drives Conference (IEMDC), Miami, FL, 2017, 1-6.

[2] Fredric Ottermo, Erik Möllerström, Anders Nordborg, Jonny Hylander, Hans Bern- hoff. Location of aerodynamic noise sources from a 200kW vertical-axis wind turbine [J]. Journal of Sound and Vibration, 2017, 400.

[3] AN Lian-qu, FENG Qiang, SHEN Guo-qing, JIANG Gen-shan, ZHANG Shi-ping, WANG Peng. Power Source Passive Positioning Method for Utility Boilers Based on Multi-delay Identification [J]. Chinese Journal of Power Engineering, 2015, 35 (10): 798-804.

[4] Zhang Liang, Liu Zhiguang, Xiao Yanfan, et al. Design of sound source localization system for electro mechanical equipment [J]. Instrumentation Technology and Sensor, 2016 (2): 49-52.

[5] Shind e M P, Gupta S N. Signal detection in the presence of atmospheric noise in tropics. IEEE Trans. Communications, 1974, 22(8): 1055-1063.

[6] Georgiou P G, Tsakalides P, Kyriakakis C. Alpha-stable modeling of noise and robusttime-delay estimation in the presence of impulsive noise. IEEE Trans. on Multimedia, 1999, 1(3): 291-301.

[7] WANG Peng, ZHANG Xiao-tong, XU Li-yuan, HE Jie, XU Jin-wu. An indoor near-field measurement algorithm based on adaptive delay estimation [J]. Acta Chimica Sinica, 2017, 40 (08): 1902-1917.

[8] Xu Chengwei. Study on the origin, diagnosis and noise reduction of air conditioning noise [J]. Science and Technology Wind, 2012 (04): 108-109.

[9] Qian Shiyu. Acoustic Camera - Making our Community Quiet [J]. Foreign Electronic Measurement Technique, 2009, 28 (02): 5-8.

[10] Li Zhiyuan, Chen Hui, Chen Pin, Lu Yimin. An acoustic power level sound intensity measurement method for large equipment [J]. VIBRATION. Testing and Diagnosticaion, 2013, 33 (02): 311-314.

[11] Junhao Li. Performance Comparison on Three Time Delay Estimation Algorithms Using Experiments [J]. Communications, 2017: 5.

[12] Jiang Rui, Li Qin, Zhong Jianwei. Analysis of power noise in distributed photovoltaic power station monitoring system [J]. Journal of Hubei Institute for Nationalities (Natural Sciences Edition), 2017, 35 (02): 219-223.

[13] Feller W. An introduction to probability theory and its applications. New York: John Wiley & Sons Inc, 1966.

[14] HE Ji-Ai, CHEN Xing. Parameter Estimation of Communication Signals and Its Development [J]. finding Technology, 2017, 36 (3): 6-10.

[15] LIU Wen-hong, ZHANG Shuai, QIU Tian-shuang. Comparison of α-stable distribution feature index estimation methods [J]. Journal of Shanghai Dianji University, 2013, 16 (04): 183-187.

[16] Guan Jiashi, Shi Daowu, Qiu Jianwen, Shi Hongwei. A Method to Estimate the Stable Distribution Symmetry Coefficient and Dispersion Coefficient [J]. Zhonghua University of Science and Technology (Natural Science Edition), 2017, 45 (09): 23-27.

[17] Nikias C L, Shao M. Signal processing with Alpha-stable distributions. New York: John Wiley & Sons Inc, 1995.

[18] Liu Wenhong. Estimation method and application of time delay under impulsive noise [D]. Dalian University of Technology, 2007.

[19] A. Chandra, Measurements of radio impulsive noise from various sources in an indoor environment at 900 MHz and 1800 MHz, The 13th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, 2002, 639-643 vol. 2.

[20] Shen Qingyue. Selection of sampling rate and quantization bit depth in audio work [J]. Bound Sound Technology, 2013 (02): 54-55 + 60.

[21] Shen Zaiyang. MATLAB Signal Processing [M]. Beijing: Tsinghua University Press, 2017: 234-258.

