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Research Article

NOISE REDUCTION BY OPTIMIZING THE AIRCRAFT ROUTE

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A R T I C L E I N F O

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A B S T R A C T

Aircraft route optimization is key area in which the airlineindustry is focusing. The optimization of the route results in the reasonable profit along with the considerable aviation noise.Aviation noise can never be completely avoided around but it can be reduced to some extent.Thepaper proposes a comparison with the four algorithms which optimizes the route along with the decibel of noise produced in that course. The results show the reduction in aviation noise when the route is optimized and the best is also obtained.

INTRODUCTION

Airports are major centers of attraction in urban areas. Their impacts are many and usually include economic, environmental and land-use issues, all of which may affect the future development of the airport.One of the major problems affecting the people living and working around airport is noise due to aircraft operation. Accordingly, residential developments near noise-sensitive airport have generated all sorts of complaints and community actions aiming to reduce noise due to aircraft operation. Today's new generation aircraft are about 75% quieter than those built 40 years ago. However, the issue of concern for many people living in these areas is not due to the level of noise generated by individual aircraft, but rather the cumulative impact of a large number of over flights. They perceive that the periods of respite are rapidly disappearing and the noise events are becoming more frequent in the sensitive time periods such as evenings and nights.This change in the nature of the noise pattern would appear to be a significant factor in the widening geographic range of adverse community reaction to aircraft noise for the community residing in the proximity of airport globally.

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Domestic (INDIA) and International Scenario

Domestic Scenario

The noise levels have been broadly classified under four categories by Ministry of Environment & Forests vide The Noise Pollution (Regulation and Control) Rules, 2000:

Table 1 Domestic Noise pollution category

Sl. No.	Category	Limits in dB(A) Leq Day Time	Night Time
1.	Industrial area	75	70
2.	Commercial area	65	55
3.	Residential area	55	45
4.	Silence area	50	40

An airport though falls under industrial area category however, the noise levels are expected to be higher in the vicinity of the airport due to frequent aircraft movements. Most of the busiest airport world over has defined a separate area known as "Airport Vicinity Zone" wherein the ambient noise levels are expected to be higher than any other category of noise levels due to arriving and departing aircraft. Considering the fact that airport are usually located within the limits of large urban areas, in order to minimize the adverse impacts of its operation, it is necessary to organize the airport and surrounding areas through the development and adoption of a set of plans that govern urban planning and management with respect to the airport. It is important to notice that each airport is different in its operational characteristics, its social, economic and political situations, as well as in the type of landuse in its surrounding areas. All of these factors must be taken into account when planning land use in the vicinity of airport.

However, in absence on a dedicated Airport zone and improper land planning in the vicinity of airport in India, the community residing in these areas are facing day to day problem due to large volume of aircraft operation. At one hand, the growth in aviation sector and airport developments is favorable to have growth in national Gross Domestic Product (GDP) but at the other hand, it leads to large annoyance to the communities residing in the vicinity of the airport.

International Scenario

Several international standards and methods to measure sound already exist to determine noise limits during the day/night due to aircraft operation in the airport vicinity. All the above mentioned standards are developed taking into account the number of aircraft movements, type of aircraft operating at that airport, geographical location of the airport, etc Some airport also provide Noise Limits for aircraft, essentially to control engine noise during approach/take off from runways. Some of the airport with noise limits are listed in table2

Table 2 List of airport with noise limits

Noise levels at International Airport			
Sl. No.	**International Airport**	**Country**	**Permissible Noise Limits (peak values)**
1.	JFK- New York	USA	99dB (A)
2.	Midway- Chicago	USA	No limits
3.	Rio de Janerio	Brazil	118.4dB (A)
4.	Brussels	Belgium	100dB (A)
5.	Rome	Italy	103dB (A)
6.	Gatwick- London	UK	94dB (A)
7.	Heathrow - London	UK	94dB (A)
8.	Stansted -London	UK	94dB (A)
9.	Manchester	UK	92dB (A)
10.	Hong Kong	Hong Kong	No Limits
11.	Melbourne	Australia	No Limits
12.	Osaka	Japan	107dB (A)
13.	Kuala Lumpur	Indonesia	No Limits
14.	CDG - Paris	France	104.5dB (A)

It is pertinent to mention that permissible noise limits at above mention airport varies primarily due to the difference in their topological locations. The airport situated in the northern hemisphere have lower noise limits than those located near the equator due to the fact that the air is more cold and dense which acts as a medium to absorb some noise.[11]In line with International Civil Aviation Organization's (ICAO) mandate to reduce or minimize aircraft noise through an established noise management programme, DGCA has initiated a proactive role to minimize the airport noise in whole. Besides reducing the noise at source, emphasis is being given to reduce the airport noise by sources other than aircraft also.[14] It has been observed that noise due to aircraft movement add to the problem of the community noise in the vicinity of the airport apart from airport noise.

Assess the aircraft noise

When assessing the environmental affect of aviation noise, the air transport method as a whole wishes to be regarded in view that overall noise and the reduction of the same is to be established.Explanations akin to plane utilization and routing grow to be very fundamental in terms of whole noise and operatingcosts.[12] This is a exchange from the historical plane design philosophy which makes a speciality of minimizing charges on a small set of missions.[13] There has been some latest work on the design of aircraft for single hub route networks, however it didn't include environmental performance as an objective or constraint [11].An method is provided in this paper that allows to optimize a set of a number of aircraft at a conceptual design stage for a detailed route network.[9] The targets of curiosity comprise the financial and noise performance of a fleet over the route network. There are a lot of choices to be made by way of the airlines to fulfill market demand. The most important picks are the size and performance of the aircraft themselves.[6] The route community overwhich the aircraft operate additionally has a gigantic impacton the monetary efficiency and total noise in the environment. In this study we considerboththe route network and the noise reduction which indicates that two objectives has to be satisfied.

Bio –inspired Algorithms for optimization of air route

We are opting for nature situated meta-heuristic algorithm considering, heuristics are in general main issue-elegant, in which we define an heuristics for a given problem to find the best solution. Meta-heuristics algorithms are challenge-independent methodologies that may be applied to a huge variety of issues for analysis among which the bio-inspired algorithms have now taken their chance to prove their efficiency. An heuristic can be like opting for a random aspect for pivoting in Quicksort. A meta-heuristic is aware of nothing about the situation it is going to be applied, it will possibly deal with functions as black bins. We can say that a heuristic exploits obstacle-elegant understanding to finda most finest or first-rate technique to an targeted predicament, while meta-heuristics are like design patterns, general algorithmic recommendations, which will also be applied to a large variety of problems. On this learn, the route profitability is optimized making use of bio-inspired algorithms like Firefly algorithm (FA), Bat algorithm (BA) and Cuckoo search algorithm (CSA), hybrid approach (BCF).[4,7] Dynamic Programming (DP) utilizing PL/SQLis used to search out the expected price of every route generated via FA, BA and CSA. Results: the target is to scale back the total expected price or maximize profit per airliner per route. The health worth of a airline and route is calculated utilizing DP. In the proposed model, we're making use of three algorithms wherein the initial particles are generated, centered on Nearest Neighbor Heuristic (NNH) which deals with the airliners. The algorithm is appliedutilizing PL/SQL and tested with issues having unique number of aviation knowledge set fromAustralian transportation from the 12 months Jan 2009 to Nov 2014. The outcome got are aggressive and confirmed some large growth over revenue, in phrases of execution time and memory usage as good.

Analysis of Algorithms in the given data set

The proposed multi-purpose BCF, firefly, bat and cuckoo search is implemented in PL/SQL to performroute profitability analysis on airline information set gathered from Australian aviation data. Firstly we have now verified thealgorithm effects for these three algorithms utilising aviation data for November 2014 which has 124 records along with 53 Australian ports and 57 2009 to November 2014 that contains 30,000 files of exact aviation ports which is the sample data set.[4]The time series plot for each algorithm along with the actual data is given in figure 7, figure 8, figure 9, figure 10, figure 11, figure 12. The results shown a great difference in the performance overseas ports. We have now carried out giant

Table 3 comparison of the algorithms over the parameters

Parameters	**Original data**	**Firefly**	**Bat**	**Cuckoo**	**Hybrid Approach BCF**
Month	14-Nov	14-Nov	14-Nov	14-Nov	14-Nov
Year	2014	2014	2014	2014	2014
# Airliners	27	27	27	27	27
# Australian ports	9	9	9	9	9
# Countries	32	32	32	32	32
# Foreign ports	55	55	55	55	55
Total distance	765696	745398.69	646873	712188	765696
Total Pax Capacity	995113	995113	995113	995113	995113
Total Paxin	865678	865678	865678	865678	865678
Total Freight Capacity	42400	42400	42400	42400	42400
Total Freight in	22557.4	22557.4	22557.4	22557.4	22557.4
Total mail capacity	12400	12400	12400	12400	12400
Total mails	1638.2	1638.2	1638.2	1638.2	1638.2
Total Fuel capacity	1301683.2	1301683.2	1301683.2	1301683.2	1301683.2
Total Fuel used	1225113.6	1192637.904	1034996.8	1139500.8	1225113.6
Total Income	29900812861	29249682013	25461304048	29797861751	30200675073
Total Expenses	27225855965	26490984885	22657951619	27028323820	27058044202
Total Profit	2860481165	2864478392	2918265155	2865026062	3264923343
Total loss	185524268.9	105781264	114912726	95488131	122292472
Nett	2674956896	2758697128	2803352429	2769537931	3142630871
Total dB(s)	47488465.92 dB / sec	46310611.8496 dB / sec	40189344..8 dB /Sec	44169899.76 dB / sec	47488465.92 dB / sec

Figure 7

Figure 8

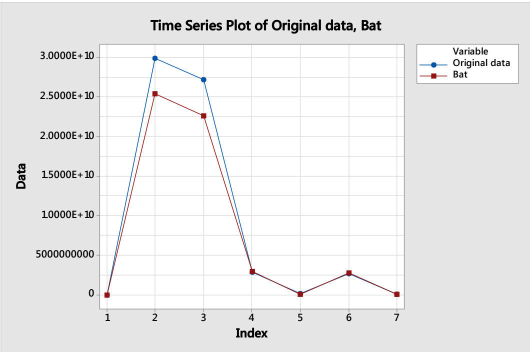

Figure 9

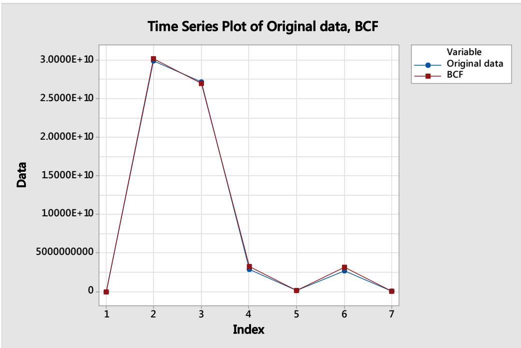

Figure 10

Figure 11

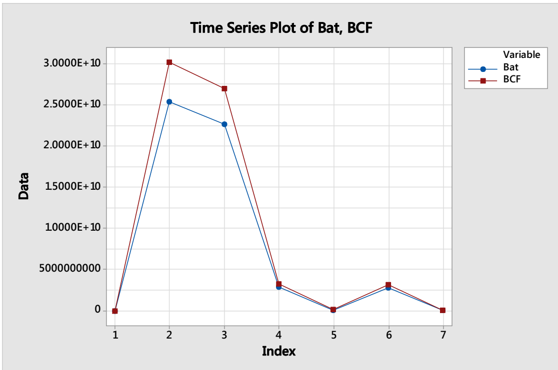

Figure 12

data analysis on aviation knowledge fromJanuary .The performance of each algorithm over the original data is displayed in the table 3.

CONCLUSIONS

The data set when run in the algorithms got to show more advantageous results more than expected. All the algorithms performed well but the best is the bat and the BCF algorithm in which the profit is increased by optimizing the routes. As per the objective the bat algorithm shows considerable change in the noise level in the atmosphere triggered by the aircraft during the flight.And there is 8.39% reduction when compared to the BCF algorithm which counts really great for the noise in the atmosphere is reduced considerably by optimizing route of the aircraft.The matrix plot for all the algorithms over the original or the actual data is given in figure 6.The hybrid BCF algorithm integrated the route seat allotment thereby increasing the net amount which is far more than the other algorithms. The performance of the Bat and the BCF algorithm is compared in the figure4, figure5.The integration of the hybrid algorithm with the other algorithms may be considered in future so as to reduce the noise level also simultaneously.

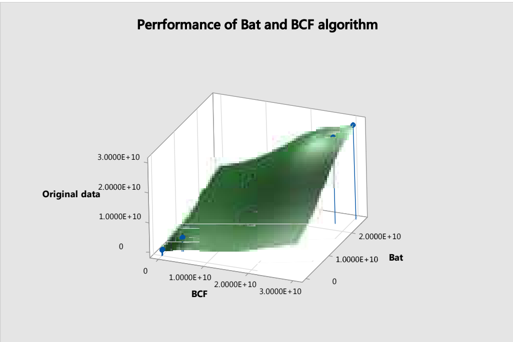

Figure 4

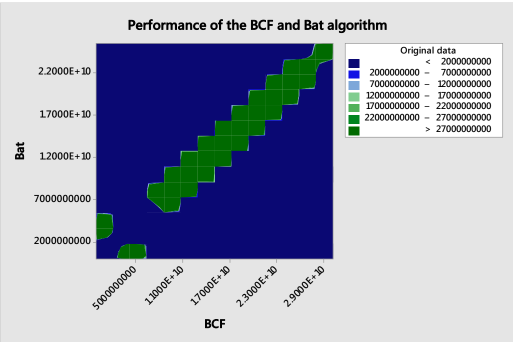

Figure 5

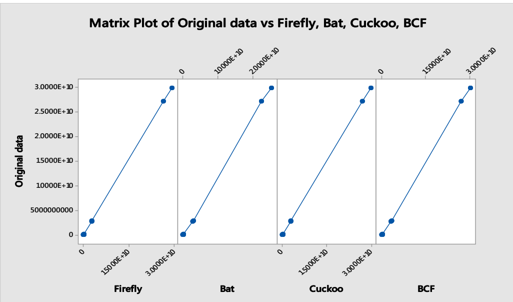

Figure 6

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