



Comparitive Study for Overall Accuracy Between Real Time and Simulated Tool Generated Data

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ABSTRACT: Direction of Arrival is one of the essential research focuses in the Real Time Acoustic Sensor Network. In the proposed work the comparison is made among real time data and simulated data collected by passive acoustic sensor at 3 different forests for estimating Direction of Arrival and localization using enhanced hyperbolic circular array. Simulation and real time experimental results shows that difference in external factors affecting the wind propagation shows the major impact on localization and error accuracy. Our results shows that unexpected changes occurred in metrological parameters strongly affects the DOA localization accuracy.

KEYWORDS: acoustic sensor; hyperbolic circular array; error accuracy; localization accuracy.

I. INTRODUCTION

Like Humans, In matriarchal society Elephants are living and it is a social beings caring for their young ones. Asian Elephants is considered to be the last remaining stronghold of the Indian sub-continent. It is home to more than half the global Asian elephant population with more than 26,000 elephants, in the wild. The government has accorded it the status of the 'National Heritage Animal' and has undertaken several conservation Measures because of valuing the important niche that elephant has come to occupy in the socio-cultural milieu of the Indian society. Elephant conservation still remains an uphill task even though Despite best efforts of the government, the society and the people at large, elephant conservation still remains an uphill task.

Necessity of the problem

Elephants are significant contribution to tourism revenue in many countries in South Africa and Asia, they have a substantial part of our cultural and historical heritage and they give us pleasure to behold. Elephant play a role as a symbol for the need for conservation of wildlife and nature. According to Tamil Nadu State Level Workshop on Elephant Corridors and Human Elephant Conflict mitigation held at The State Forest Service College Coimbatore on April 10, 2010. It was organized by Wildlife Trust of India with support from Tamil Nadu Forest Division and Project Elephant (MoEF). Here are few important points discussed in the Workshop:

R.Kannan, Conservator of Forests, Coimbatore Division

1. 56 elephants lost its lives from 2006 in CBE Division. 12 were electrocuted and 4 in Railway accidents.
2. 29 Human lives lost in 2009.
3. 11 human lives lost in 2010 so far.
4. 95 human lives lost from 2001.
5. 277 crop damage claims received from farmers in 2009.
6. 180.8 kms of solar fencing from 2001. 350 kms are vulnerable areas[16].

Elephants are valuable in their own right. Therefore, interest has been growing in detecting elephant for safety. The rest of the paper is structured as follows. Chapter 2 discusses the existing approaches for finding the Direction of Arrival.



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Chapter 3 explains the hardware audio recording circuits. Chapter 4 reveals the block diagram of Proposed Methodology. Chapter 5 outlines the Results and Analysis. Finally, Chapter 6 concludes the paper.

II. LITERATURE SURVEY

Specific target DOA estimation in forest is one of the essential sensor network applications in forest. Estimating DOA for an acoustic source of narrow band sources where origin of the source is far away from the sensor array optimal algorithm are processed in existing techniques such as multiple signal classification (MUSIC) the minimum variance method of Capon, estimation of signal parameters via rotational invariance technique (ESPRIT) and more. Better performance was achieved at higher the SNR.

The standard method for estimating DOA is ML method[5]-[7]. Observed parameters are essential for formulating likelihood function. Estimation of ML with respect to all unknown parameters, which may include the source DOA angles, the signal covariance, and the noise parameters by maximizing the likelihood function. There are different optimization techniques available in literature for optimization of ML function like AP-AML, simulated annealing (SA), genetic algorithms (GA) fast EM and SAGE algorithms and a local search technique e.g. Quasi-Newton methods. The evolutionary algorithms like genetic algorithm, particle swarm optimization and simulated annealing can be designed to optimize the ML function. Genetic algorithm and particle swarm optimization had already used as a global optimization technique to estimate the DOA for uniform array[14]-[15].

III. SENSOR HARDWARE AUDIO RECORDING CIRCUITS

For recording the real time elephant sound and other sound there is a need for sensor circuits. The following theory illustrates the working methodology of sensor circuit and block diagram of the sensor circuit. The total circuit in 5V/DC and the audio with direction will be identified by the sensor. For 5V/DC supply we convert the 230V/AC supply from the source. Then we give the AC supply voltage to the potential transformer on primary side. Then use the step down transformer so that the supply voltage will get reduced to 12V/AC. The 12V/AC supply will be connected to the bridge rectifier circuit to convert the AC supply to DC supply; here the 12V/AC will be converted into 12V/DC supply, using the regulator 12V/DC supply will be converted or reduced to 5V/DC supply with noise filtering. Then the supply voltage of 5V/DC supplied to the main circuit to operate.

The sensor is connected to the main board circuit, here the sensor will give the analog signal and that will be converted into digital signal with inbuilt Analog to Digital Converter tool in our controller. Then at the same time the data will be automatically stored in micro memory card.

IV. DIRECTION OF ARRIVAL ESTIMATION BLOCK DIAGRAM

Using a pair of microphones, the proposed technique estimates the minimum distance and Time Difference of Arrival between the microphone and acoustic source. The retrieved digital signals are post-processed by the PC to determine the DOA arrival. Using this minimum distance calculation, the acoustic source Direction of Arrival (DOA) with respect to the microphone array is arrived and represented in the following figure(1).

The above process is repeated for all the microphones when the acoustic source is present within the region of sensor array. The trigonometry angles are considered in order to estimate the sound source location and distance estimation between source and sensor.

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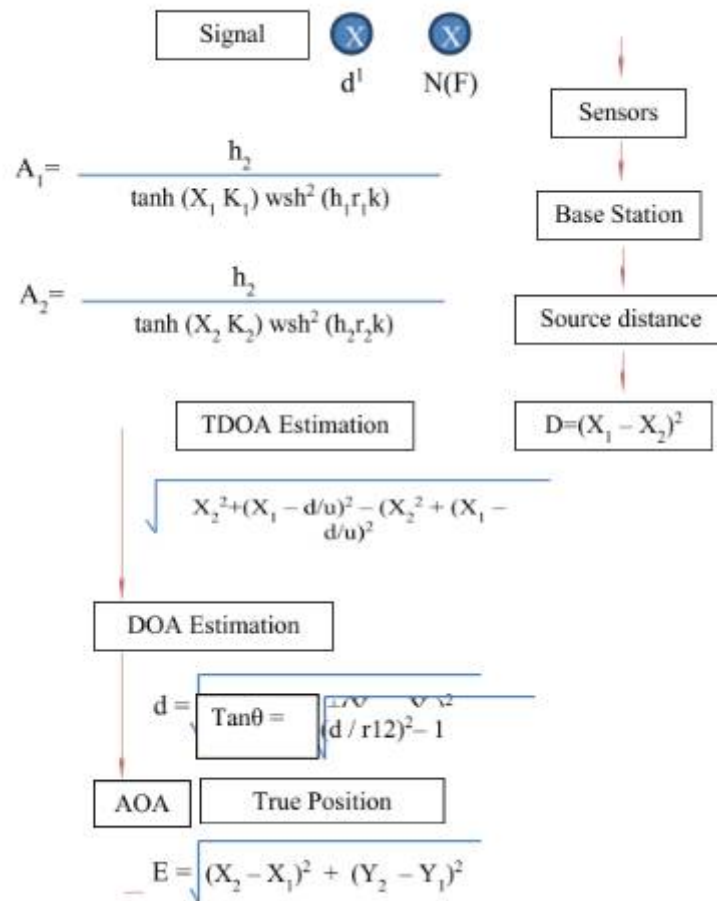


Fig 1. DOA estimation block diagram

V.SIMULATION RESULTS AND DISCUSSIONS

To check the accuracy of Direction Of Arrival estimation and localization , real time implementation are carried out for recording the elephant vocalization using acoustic sensor at forest areas. At the time of data recovery from the sensor network DataBase Management System we have encountered the state of affairs such as idleness of noise stored in sensor. In order to abolish the duplication of signal the proposed methodology has been implementing the SPIN (Sensors Protocol for Information Via Negotiation) protocol[1]-[4]. During real time acoustic recording there are 50 different external factors encountered such as (temperature, wind, lightning, echoes, thunder, reflection, refraction, scattering, etc) affecting the elephant sound propagation at forest. In our experimental analysis each acoustic microphone array are separated by 0.5M(metres) and circularly sensed the acoustic signal by 3Kms and each sensor node deployed circularly 360° deg by TOP, BOTTOM, LEFT, RIGHT[11]. The experimental results are carried out by MATLAB WAVE tool and analysed the overall accuracy of Direction Of Arrival estimation for real time and simulated data. Figure (2) and (3) shows the overall DOA accuracy for real time data (96%) and simulated data 92% accuracy

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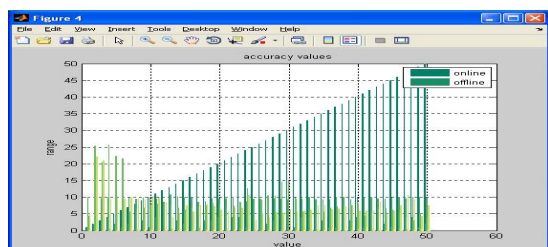


FIG 2: Over all accuracy range for real time and simulated data

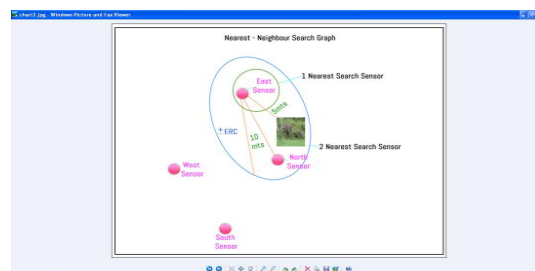


FIG 3. Nearest neighbor sensor search

VI. CONCLUSION AND FUTURE SCOPE

The proposed methodology for estimating route of arrival by means of differential hyperbolic circular array and nearest sensor localization shows the major impact and analysis of external metrological constraints such as temperature, wind and unexpected changes affects the accuracy of elephant localization. The SNR, RMSE error and ECF also plays the major role in Error rectification and Localization accuracy. In real time and tool generated implementation the localization error constant factor is estimated as $-0.11\text{Mts}(-5.824/50)$. In future our work focusing on two directions (i) increasing the number of sensors and decreasing the error constant factor (-0.11Mts) (ii) Estimating the direction of arrival for moving objects in land and sea.

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