PREMILINARY STUDY OF OUTDOOR POSITIONING ACOUSTIC SOURCE DIRECTION OF ARRIVAL

Mr. M. Mayilvaganan, Associate Professor Department of Computer Science, P.S.G college of Arts and Science, Coimbatore 641 014. Email: Mayil24_02@yahoo.co.in

M. Devaki, Research Scholar, P.S.G college of Arts and Science, Coimbatore 641 014. Email: dev7aki@gmail.com

Abstract: Wireless sensor network systems have become revolutionize in recent years. Acoustic source Direction Of Arrival (DOA) is one of the essential phenomenon in many applications. Acoustic sensor network can provide a way to simulatenous monitor and interaction of many sources. This paper provides an preliminary study of Direction Of Arrival (DOA) for outdoor positioning and attempt to classify the different approaches. We focus on Dominant Frequency Selection (DFSE), Approximate Maximum Likelihood (AML) and Multiple Signal Classification (MUSIC) methods. We then illustrate and discuss the methods for Direction of Arrival.

Keywords: Direction Of Arrival (DOA); acoustic source; Dominant Frequency Selection (DFSE); Approximate Maximum Likelihood (AML); Multiple Signal Classification (MUSIC)

INTRODUCTION

Outdoor acoustic sensor network is one of the emerging technology in recent years. Acoustic sensor network provide a new method for automatically detecting the Direction Of Arrival (DOA) and simultaneously monitor the multiple sources [1]. Estimating the Direction of Arrival is one of the important phenomenon in many applications radar, sonar, radio, astronomy, under water surveillance and seismology etc [7] to estimate the source location and direction. An acoustic beamformer has been proposed to outdoor positioning to obtain DOAs of single or multiple sources are estimated using multiple signal classification (MUSIC) algorithm [3]. To acheive high accuracy of DOA estimation, this beamformer requires a large number of microphones [7] [3].
In our design of acoustic sensor networks for outdoor localization, we choose the approximate maximum likelihood (AML) method to estimate DOA of source using synchronized audio channels of each acoustic array[7]. AML is an optimal DOA estimator can also estimate DOAs of multiple simultaneous acoustic sources. Since AML needs only a small number of requirements on memory space, CPU speed, and power consumption for data processing in very high speed[8]. Separate DOA estimates can be made from Dominant frequencies which is present in the broad band signal. Calculating the mean of the independent estimates used as a accurate DOA. In general the frequency components have some fluctuations[8]. We reduce the fluctuations, by selecting the maximum components of the Fast Fourier Transforms (FFT) results of the bandpass filter outputs.

\[ d \leq \frac{1}{2} \left( \frac{v}{f_{\text{max}}} \right) \]

Band pass filters were used to implement the DOA estimation. The frequencies are filtered and cut off as they would not meet the required condition.

**DOA ESTIMATION TECHNIQUES**

**Description of Dominant Frequency Selection Algorithm (DFSE)**

Seperate DOA estimates can be made from Dominant frequencies which is present in the broad band signal. Calculating the mean of the independent estimates used as a accurate DOA. In general the frequency components have some fluctuations[8]. We reduce the fluctuaions, by selecting the maximum components of the Fast Fourier Transforms (FFT) results of the bandpass filter outputs. Band pass filters were used to signals and implement the DOA estimate algorithm.
Figure 1.1 Structure of the ‘L’ shaped microphone array

DOA of the source that uses the dominant frequency components of the signal. The system is constructed by microphones arranged in ‘L’ fashion. Band pass filters were used to extract the signal in desired frequency range. Using a pair of microphones, we estimate the dominant frequency signal[2][8]. Using the phase difference DOA are estimated for a pair of microphone. The frequencies are filtered and cutt off as they would not meet the required condition.

Approximate Maximum Likelihood (AML)

Approximate Maximum Likelihood (AML) is a sound localization technique and it will separate individual source from the many sources of noise in recording from tropical rain forests[4]. The maximum-likelihood (ML) estimator is one of the upgrading method to estimate the DOA under multi source challenging environemnt. For example, an ML estimator can be tailored to large bandwidth exhibited by wideband signals[5]. AML can also be performed acoustic beamforming. Beamforming can effectively improve the quality and signal-to-noise ratio of recorded vocalizations[5][7].

Microphone ,Wave file & Wide and narrow band stream | Audio server | Audio matching | DOA | Source localization

source 1 | source 2 | source n
Figure 2.2 Architecture of the AML system

**Multiple Signal Classification (MUSIC)**

An acoustic beamformer has been proposed to outdoor positioning to obtain DOAs of single or multiple sources are estimated using multiple signal classification (MUSIC) algorithm [11]. To achieve high accuracy of DOA estimation, this beamformer requires a large number of microphones [5]. Each beamformer requires a large amount of memory and a high-speed CPU for real-time processing. Multiple signal classification (MUSIC) algorithm [4] is a optimal DOA estimation algorithm for narrowband signal. For estimating the wide-band signal DOA estimation, we will divide the wideband signal into many narrowband components and then apply MUSIC on those narrowbands [5][7]. The DOA estimation is generated by combining estimated results from all the narrowband components.

![Diagram of DOA Estimation for Wideband Source]

**FIGURE 3.3 DOA Estimation for wideband source**

**CONCLUSION & FUTURE TRENDS**

This paper, describes preliminary study of outdoor positioning acoustic source Direction Of Arrival. It helps to develop new techniques to monitor simultaneously estimate Direction Of Arrival and Time Of Arrival, Localization and identifying individual source separately. These ideas strongly implement in the future.
Our future work enhances simultaneously monitor tropical birds in highly reverberant areas and estimating the Direction Of Arrival for multiple sources.

REFERENCES


