IMPERIAL COLLEGE of SCIENCE, TECHNOLOGY & MEDICINE

DEPARTMENT of ELECTRICAL & ELECTRONIC ENGINEERING

MSc in Communications and Signal Processing

Formal Report No. 1

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Name	Student
Experiment Code	AM1
Title of Experiment	Array Communications & Processing
Date of Submission	10/01/2009
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Grade	

Communications, Control and Signal Processing Laboratory

Array Communications & Processing

Aims—Provide a theoretical framework for handing various problems in a number of different applications. Emphasis will be given to “Supperresolution” approaches.

I. BACKGROUND

By distributing a number of receiving elements in a 3-dimensional in a Cartesian space, an array is formed.

The general array processing problem is the obtaining of information about a signal environment from the waveforms received at the array elements, where the signal environment consists of a number of emitting sources plus noise.

However, a new ‘hot’ application of arrays is in the area of digital communications where space-time and not just time information associated with communication signals can be utilized to provide more sophisticated and powerful communication systems.

Thus, by integrating array theory with digital communication theory, new communication system architectures are being proposed which have a considerable impact, by suppressing co-channel interferences, combating fading effects, estimating other signal environment paraments.etc.

II. INTRODUCTION

Supperresolution methods main object is to improve the resolving capabilities by using a model for the signals better than that used by Fourier methods. It eliminated the effects of the signal-to-noise ratio on resolution, in contrast to the conventional methods where the resolution is limited by noise.

Thus, this experiment provides a tutorial mechanism regarding array processing techniques with main objectives to:

- Estimate the number of the emitting sources.
- Provide complete information about the direction of the emitting sources.
- Investigate the use of an array of sensors for detecting and rejecting in-band interferences.
- Estimated relative powers, cross – correlation, etc.

III. PROCEDURE

$$AIC = 10^3 \times \begin{bmatrix} 9.2461 \\ 8.1370 \\ 3.2966 \\ -1.0474 \\ 0.0480 \end{bmatrix}$$

$$MDL = 10^3 \times \begin{bmatrix} 4.6231 \\ 4.0640 \\ 1.6403 \\ -0.5342 \\ 0.0120 \end{bmatrix}$$

From the above vector of AIC and MDL, the fourth element is minimum, so

$$M = 4 - 1 = 3$$

This means this system having three sources.

Summary

If L= finite (i.e. Practical Covariance matrix $R_{xx} = \frac{1}{L} X.X'$)

Then

M = can be found using AIC or MDL

σ^2 =the ave. of the N-M smallest eigenvalues

$=\frac{1}{N-M}(\sigma_{M+1}^2 + \sigma_{M+2}^2 + \ldots + \sigma_N^2)$

notes: N= number of array elements

M=number of signals

IV. CONCLUSIONS

In a practical applying, most of cases, the receiver will receive interference signals that may be transmitting in the same frequency band of our desired transmitter at the same time. A good solution to settle such a problem is to use an array of sensors (receivers) and try to detect and locate all the sources and suppress the interference. We showed that using the covariance matrix of the received signals we can detect the number of sources and showed that by MuSIC Algorithm we were able to find the direction of arrivals and design a beamformer to suppress the interference. Two different beamformers were discussed, W-H and Superresolution beamformers. The first one yield to acceptable result while using theoretical values while the second one produced a great array pattern for practical signals as well.

V. ACKNOWLEGEMENT

The author wishes to acknowledge the help and support given to him during the experiment.

Thanks go to:

Prof. A. Manikas (Academic in charge)

Mr.Kai Luo (Lab Demonstrator)

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