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Migration of 5.0 Multichannel Microphone Array Design to Higher Order MMAD (6.0, 7.0 & 8.0) with or without the Inter-format Compatibility Criteria

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ABSTRACT

The severe limitations of the 5.0 Multichannel Reproduction Standard in reproducing good quality audio-visual or stand-alone audio surround sound reproduction has increased the pressure on recording and reproduction system designers to increase the number of channels in an attempt to give an even more satisfactory envelopment experience. This paper extends the MMAD process to show how higher order channel array designs (6.0, 7.0 and 8.0) can be developed from the existing data on 4.0 or 5.0 Multichannel Front Sound Stage Coverage Array Designs with almost perfectly seamless and linear surround sound reproduction. Designing for inter-format compatibility can also be accommodated from the existing multi-format array design data described in a previous paper on Multichannel Arrays Generating Inter-format Compatibility (MAGIC arrays)[(3)].

1. INTRODUCTION

The Standard 5.0 Multichannel Loudspeaker Configuration Recommendation ITU - BS.775-1 was created essentially as an audio support configuration for Cinema and Home Theatre sound reproduction. Even in this environment the only segments giving satisfactory virtual sound reproduction are within the frontal sound field of 60° created by the left, centre and right loudspeakers - this is obviously the segment usually occupied in Cinema or Home Theatre reproduction by screen related sound. The lateral segments however suffer from a certain amount of angular distortion and a natural decrease in resolution at 90° and 270° with respect to the listener in the centre. Whereas the back segment, which should show reasonably good localisation, is rendered almost unusable due to the high degree of angular distortion created by the wide angular spacing of the Ls and Rs loudspeakers. Although many attempts have been made to reduce these defects by generating additional channels from the 5 channels transmitted in a 5.0 multichannel format, it has been increasingly evident that the most satisfactory solution would be to increase the number of primary channels. The arrival of the 7.1 multichannel structure with the Blu-Ray and HD DVD disc formats has obviously highlighted the need to design satisfactory higher order (6.0, 7.0 and 8.0) multichannel array systems to meet the need for a high quality audio-visual and especially stand-alone surround sound recordings.

2. HIGHER ORDER MMAD (6.0, 7.0 & 8.0)

First of all let it be clear that the title 'Higher Order MMAD' means a higher number of channels i.e. greater than the multichannel 5.0 standard of 5 channels, not a higher order directivity pattern for the microphones. The arrays designs described in this paper apply to standard 1st order directivity pattern microphones. In MMAD approach to array design it is not necessary to revert to higher order directivity patterns to obtain satisfactory localisation performance, thereby taking advantage of the excellent performance of some of the standard small diaphragm studio condenser microphones.

Three specific approaches to array design using the MMAD procedure will be described

- Equal segment array design
- Complimentary 'back-to-back' array design
- Interformat compatible array design

2.1 Equal Segment Surround Sound Array Design

The very beginning of the Multichannel Microphone Array Design process was described in a paper presented to the 91st AES convention in New York in 1991[1]. This paper described the principles behind the migration of two channel stereo to equal segment microphone arrays for 4, 5 or 6 channels. Although at the time it seemed almost impossible to envisage the eventual use of higher order channel arrays, new media technology has inevitably overtaken us. The same principles of equal segmentation of the sound field can of course be applied to these new higher order equal segment designs as well as to the older designs, as shown in Figures 1, 2, 3, 4 and 5.

The extended SRA diagrams in Figures 6, 7 and 8, show how the unique values of angle and distance can be determined in order to specify the configuration of each array for 4, 5, 6, 7 and 8 channels, and for each of the usual 1st order directivity patterns. These configurations still remain a most reliable, satisfactory and compact sound recording tool for multichannel recording and reproduction - indeed a number of proprietary array systems, which conform to this design procedure, have since seen the light of day.

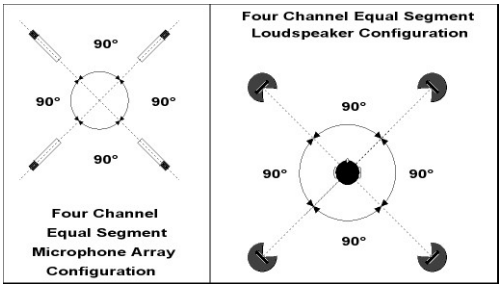

Figure 1

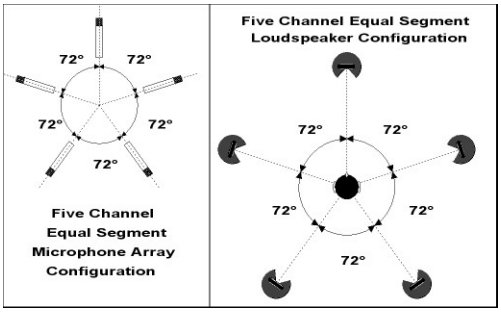

Figure 2

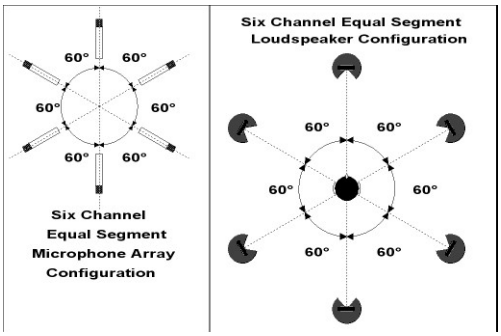

Figure 3

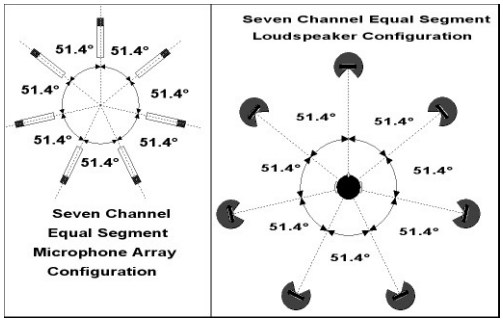

Figure 4

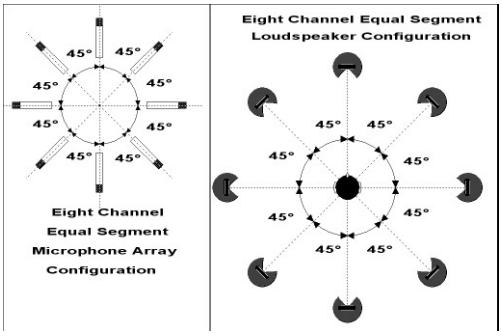

Figure 5

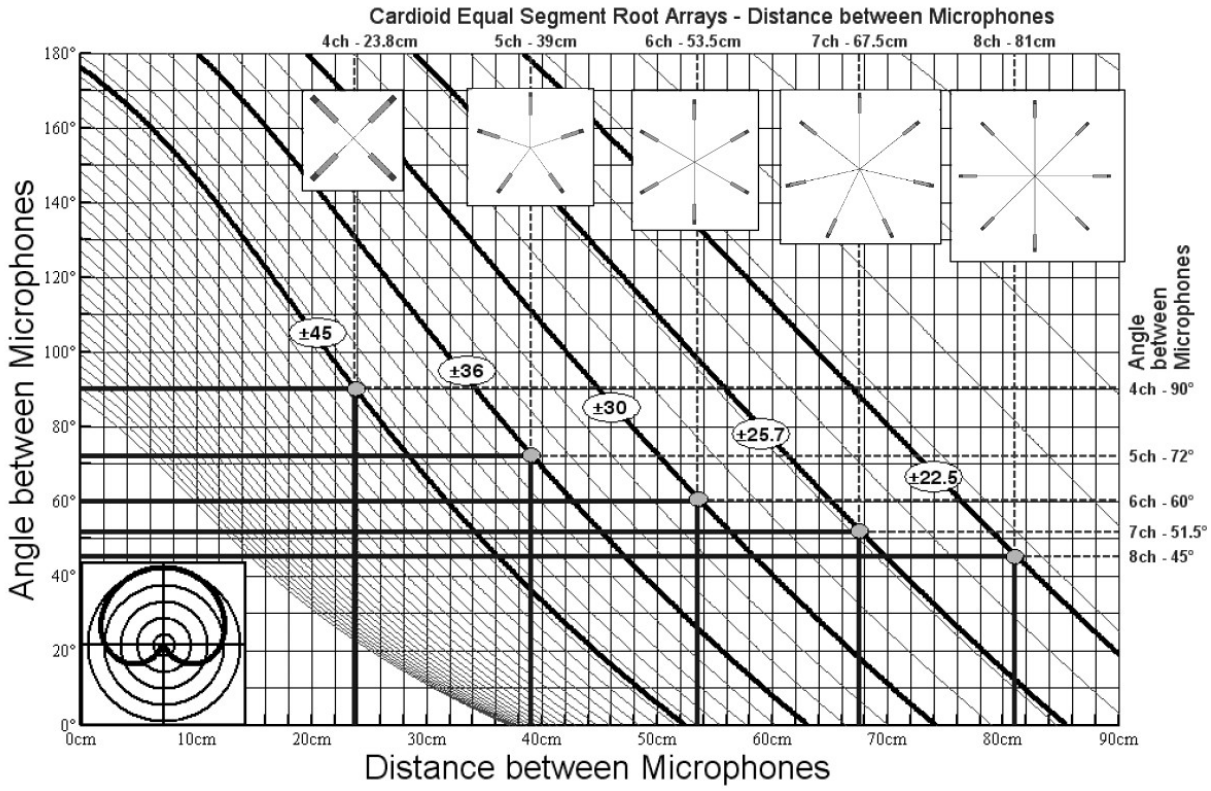

Figure 6

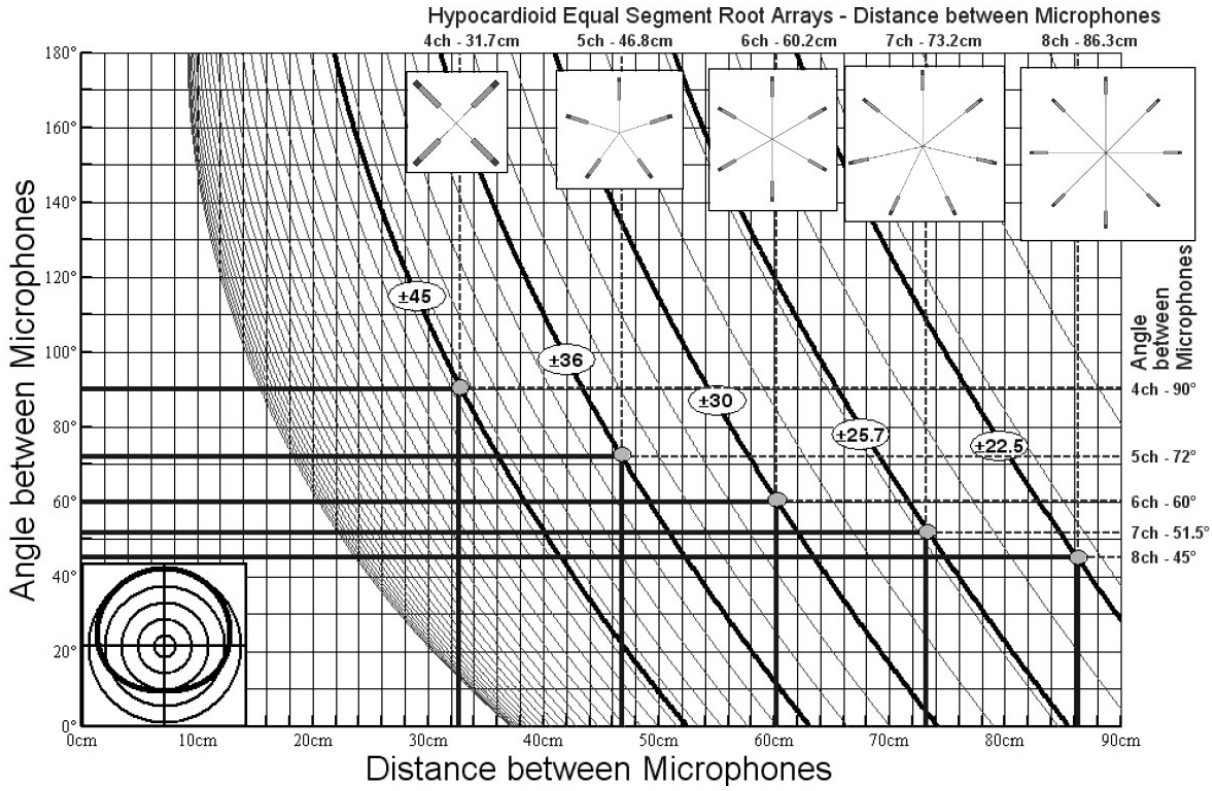

Figure 7